THE FOUNDRY

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Foundrymen Discuss Many Important Problems

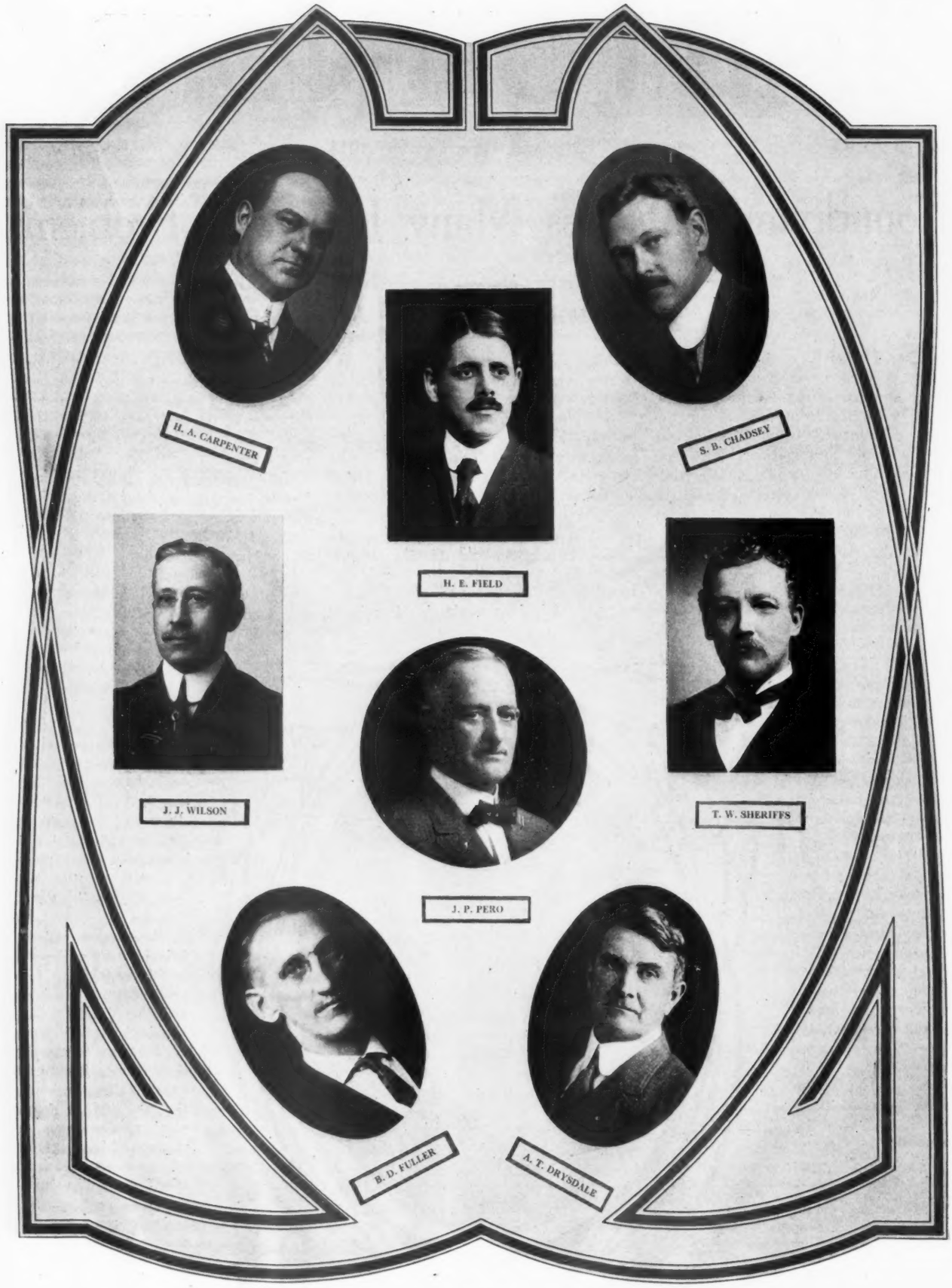
Report of Annual Meeting of American Foundrymen's Association in Chicago—Over Forty Papers and Reports Presented

MEASURED simply by the volume of the papers, reports and discussions presented, the nineteenth annual convention of the American Foundrymen's Association, which was held at Chicago, Sept. 8-11, stands alone. But a convention should be judged by the quality and character of the results achieved, rather than merely by the quantity of matter presented. Viewed from this angle, it seems safe to say the Chicago convention marks a turning point in the career of the American Foundrymen's Association. The meeting showed that the organization is alive, awake to the possibilities of the hour and imbued with the same progressive spirit that has characterized it since the beginning.

Interest during the week centered around the several dramatic, extemperaneous addresses given by men of prominence in the industrial world and the reports of various technical committees. Among the latter, the report of the committee on steel foundry standards deserves special recognition, not only by virtue of its interest and value, but because it points the way for future efforts. For the first time, also, an entire session was devoted to malleable foundry practice, with gratifying result. Of particular significance was the great interest manifested at the joint cost and safety congresses, indicating that foundrymen are more than ever alive to the importance of these two subjects. In addition, both the A. F. A. and A. I. M. contributed a large mass of valuable, new information relating to metallurgy and shop practice. In connection with the convention, there was held at the International Amphitheatre, the usual exhibition of foundry and shop equipment, which is completely described elsewhere in this issue. The attendance at the exposition and the technical session was gratifying and at the cost congress it was estimated at least 500 persons listened to the proceedings.

R. A. BULL,
President, A. F. A.

The convention was called to order Tuesday morning at the Hotel La Salle with the allied organizations sitting in joint session. H. O. Lange, chairman of the general committee of Chicago foundrymen, extended a cordial welcome to the visiting delegates. His address was responded to by A. E. Howell, president, and R. A. Bull, senior vice president, American Foundrymen's Association; G. H. Clamer, president, American Institute of Metals, and S. V. Blair, president, Associated Foundry Foremen. President Howell introduced the new secretary-treasurer of the American Foundrymen's Association, A. O. Backert, who made a brief address and read a telegram from his predecessor, Dr. Richard Moldenke. Dr. Moldenke regretted his inability to attend the convention and expressed his hope that the various technical sessions would prove highly successful. The convention then immediately proceeded to the technical end of the program. The first session, which was held jointly by the three organizations, was devoted to the



VICE PRESIDENTS OF THE AMERICAN FOUNDRYMEN'S ASSOCIATION

discussion of safety and sanitation work in foundries. One of the principal speakers was M. W. Alexander, General Electric Co., West Lynn, Mass., whose remarks aroused a large amount of enthusiasm. Mr. Alexander came to the convention equipped with samples of paraphernalia which he has developed during the past year for safeguarding workmen from accidents. These included goggles, shoes and leggings particularly adapted to use in the foundry. The goggles which the speaker exhibited were provided with large glasses, in order that the workman might be assured a wide range of vision, and with flexible steel frames which could be adjusted as desired. The shoe which he displayed was of the congress type and he called particular attention to the fact that the leather was of the chrome tanned variety. This, he said, was preferable to the bark tanned leather, which, while cheaper, is more liable to develop cracks and stretch in service. The speaker also exhibited a new style of legging made of canvas and fastened to the leg by means of ordinary bicycle clips. This type of legging permits of immediate removal if molten iron should enter it. Mr. Alexander suggested that it would be to the interest of every foundry employer to make a study of the most frequent and dangerous accidents encountered in foundries, to the end that deaths and injuries may be prevented wherever possible. The commonest cause of accidents, he said, is lack of care on the part of the workmen and it therefore should be the chief aim of the employer to see that the workmen exercise care. Personal caution, he said, is the greatest safeguard. Mr. Alexander recommended that the aisles in foundries be kept clear of all obstructions in order that workmen, and particularly molders carrying iron, may not stumble and thus endanger themselves and others. For indicating danger spots he recommended the use of small signs which should bear an arrow pointing in the direction from which danger may be expected. The speaker also recommended that large foundries should maintain a dispensary and employ a physician. In addition he said the large plants should train men in the art of giving first aid to the injured. Even the smaller foundries, he said, can afford to have on hand a man who is versed in this art. Mr. Alexander exhibited a glass jar of unusually interesting construction containing a complete set of ointments, medicines and the paraphernalia necessary in case of emergency.

An interesting paper, which was submitted by A. W. Gregg and G. F. Kent, was devoted to a description of the accident prevention work of the Bucyrus Co., South Milwaukee, Wis.

This paper showed that the Bucyrus Co. reduced its accident ratio from 13.35 per cent of the number of employes in 1910 to 4.76 per cent in 1914. This shows a reduction of serious accidents of more than 65 per cent. During 1913, the Bucyrus Co. had a total of 1,224 accidents in its South Milwaukee plant, and the records show that only six of them could have been prevented by a mechanical guard. In order more fully to follow up the work that has already been done, the Bucyrus Co. has provided a new safety organization, which was described in this paper. It consists of a central committee, a works committee and several shop committees.

The reading of this paper was accompanied by lantern slides showing safety devices, danger signs, etc.

Progress in Safety Movement

"Progress in the Safety Movement and the Latest Aids to Good Safety Work," was the title of a paper submitted by Arthur T. Morey.

"The public," said Mr. Morey, "still looks at factories, railroads and powder plants and considers abnormal conditions as the cause of accidents, instead of realizing that they are only the results of common habits of carelessness. The big accidents, like the Titanic disaster, are not sporadic happenings under unusual circumstances, but come largely from racial habits of careless thought, and the man who causes a great catastrophe is anathematized for manifesting a racial characteristic. Through thorough organization and the enlistment of the cooperation of its employes," said the author, "the accident record of the Commonwealth Steel Co. shows a reduction in compensation loss of 73 per cent." This paper described the safety organization of the Commonwealth company and also referred to the work of the National Council for Industrial Safety.

A paper on "Safety First," by F. W. Reidenbach, dealt with the causes of accidents and suggested preventive measures and remedies. After making a thorough examination of a large number of casualties, the author concluded that the most vital causes of industrial injuries are lack of proper education and the use of intoxicating liquors. He, therefore, suggested that steps be taken so that all men employed in shops and foundries will have at least a common school education and that total abstinence be insisted upon.

A large number of valuable suggestions on how to avoid grinding wheel accidents were embodied in a paper by R. G. Williams, Norton Co., Worcester, Mass.

Mr. Williams recommended that the speed of the wheels should be rigidly controlled and under no circumstances should the limit set by the manufacturer be exceeded. Washers or some compressible material should be used between the wheel and the flanges. All flanges, either straight or safety shape, should be relieved. Wherever operating conditions will permit a well designed, substantial protection hood should be used. In such situations a tapered wheel and flanges of a corresponding taper are not necessary. Where protection hoods cannot be used, tapered wheels with safety flanges are the next best thing. Exhaustive tests, however, indicate that safety flanges alone do not afford complete protection.

Fred Moerl, Chicago, submitted a paper entitled "Sanitation and Safety First in the Brass Foundry." It is published in full elsewhere in this issue.

The occasion for a second joint session, participated in by the three organizations, was the cost congress, held Wednesday morning. At this session a great deal of light was shed on the careless methods employed by a great many foundrymen in computing their costs.

One of the most interesting papers was that on "Foundry Cost Keeping," by F. V. Stephenson, cost expert of the National Association of Stove Manufacturers, Hoosick Falls, N. Y. The speaker emphasized the pressing need for the adoption of a standard method of cost keeping in foundries, to the end that "some concerns would cease to sell $1 worth of goods for 90 cents." He admitted the impossibility of developing a system of cost keeping which should be above criticism and said that in a great many cases, one cost theory is as good as another. Concerted action, he said, should be taken by foundrymen to determine upon a satisfactory method of keeping costs and this should be adopted as standard in order that all foundries may compute their costs in the same general manner. Mr. Stephenson recounted the efforts he has made during the past year to further the adoption of similar cost theories by manufacturers of stoves and believed that before the end of the present fiscal year practically all of the large stove manufacturers in the country will have fallen in line.

In a paper entitled "Estimating the

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Selling Price of Castings," A. O. Backert, secretary of the American Foundrymen's Association, described the results of an investigation he conducted in an effort to ascertain the methods pursued by foundrymen in estimating the selling price of castings.

Revision of A. F. A. Cost System

An especially interesting paper was contributed jointly at this session by Harrington Emerson and J. K. Mason, two of the country's foremost cost experts. This paper constituted a revision of the standard foundry cost system of the American Foundrymen's Association. The text was devoted mainly to an explanation of the cost keeping chart which accompanied the paper. This cost system is based on the following general principles: There are three basic causes for expense — material,, labor and capital charges. Foundry cost may be divided into four divisions, metal costs, conversion cost, floor cost and cleaning costs. Cost analysis is simply the separation of the three basic expenses into charges against each item of the four divisions mentioned above. The reporting of gross foundry cost is merely the re-assembly of the analysis, to tell the story of operation step-by-step as the details mass into a cumulative total.

Frederic A. Parkhurst, Aluminum Castings Co., Detroit, contributed a 133-page discussion entitled "Scientific Management in the Foundry."

Bonus System

In discussing this paper, F. H. Schutz, of the H. Mueller Mfg. Co., Decatur, Ill., described the bonus system which has been in operation at this company's plant for about 10 years. This system is of the "flat" variety, which, the speaker contended, to be preferred to the differential bonus system. The latter system, he said, usually provides for the payment of a higher price per casting to the molder than that on which the company bases its selling price. In consequence, the differential system, he said, works almost entirely to the interest of the workmen. In the Mueller plant. Mr. Schutz said, the management decides what number of molds on a certain job are to constitute a day's work, and for each mold in addition to this number, the molder receives compensation based on the corresponding pro-rata of the day's pay. The company, he said, discourages any tendencies on the part of the workmen to consider this bonus as "spending money," by paying it out only every three months. By this method each molder receives four times a year a check which generally ranges between $20 and $150. Some of the molders employed by the company use this money to buy homes.

L. L. Anthes presented a paper entitled "Industrial Pioneering, or the Location of a Foundry in a New Territory." The many problems that must be considered by a manufacturer before locating a plant in a new territory, and difficulties which will arise in the employment of men, were brought out by the author. The question of selecting the site with its possible market, bonus propositions, railroad facilities and contiguous markets was given careful consideration. The plant referred to by the author is located in Canada where extremes of temperature prevail in summer and winter. This necessitates the construction of a plant that will protect the employes regardless of climatic conditions and the cost of building is a factor that should receive more than ordinary attention. Other factors that must not be overlooked are the labor market, basis of wage payment, relations with other manufacturers, cost of living, etc. The author states that the pioneer in manufacturing, like any other pioneer, must have youth, optimism and determination, as well as a certain amount of cash in hand.

R. A. BULL

R. A. Bull was born at New Albany, Ind., in 1874. He acquired his higher education at Butler College and at St. Louis University, receiving degrees of A. B. and A. M., respectively.

Mr. Bull's foundry experience followed five years' service as inspector for Robert W. Hunt & Co., and has covered fourteen years in the following positions: Chief inspector and foreman of pipe runs, U. S. Cast Iron Pipe & Foundry Co., Bessemer, Ala.; chief inspector, Shickle Harrison & Howard Iron Co., East St. Louis, Ill.; general foreman, Leighton & Howard Steel Co., East St. Louis; assistant to vice president and general manager, Leighton & Howard Steel Co., St. Louis; district inspector for the East St. Louis and Granite City plants of the American Steel Foundries; chief clerk to second vice president and later chief clerk to general sales agent, American Steel Foundries, St. Louis; manager order department with the same company, New York City; assistant works manager, general superintendent and manager of production, Commonwealth Steel Co., Granite City, Ill., where he now holds the latter position.

Mr. Bull is president of the American Foundrymen's Association; is a past president of the St. Louis Foundrymen's Club; is on the executive board of the St. Louis section, American Institute of Mining Engineers. He is a member of the British Iron and Steel Institute, the American Society for Testing Materials, and the American Institute of Metals. He has contributed periodically to the technical press.

"Elimination of Waste Motion in Bench Molding" was the title of a paper presented by R. E. Kennedy and J. C. Pendleton, of the foundry department of the University of Illinois.

The authors pointed out that every shop has almost an unlimited number of opportunities for reducing time and cost with only a very small expenditure of money. The necessary changes can be brought about by following out the suggested improvements shown by the careful time and motion studies. In order to show in a concrete way what can be done along this line, the authors made a study of bench molding and found that there were three principal causes for delay. In many cases the tools were not in the most convenient positions for handling; in others the workman did not have the necessary tools nor were those he did have in good shape; in still other cases the molder did too much unnecessary work. These three causes for decreased production were analyzed in considerable detail and an improved design for a molder's bench was presented.

Training Foundry Leaders

"Training for Foundry Leaders at Wentworth Institute," was the title of a paper submitted by E. A. Johnson.

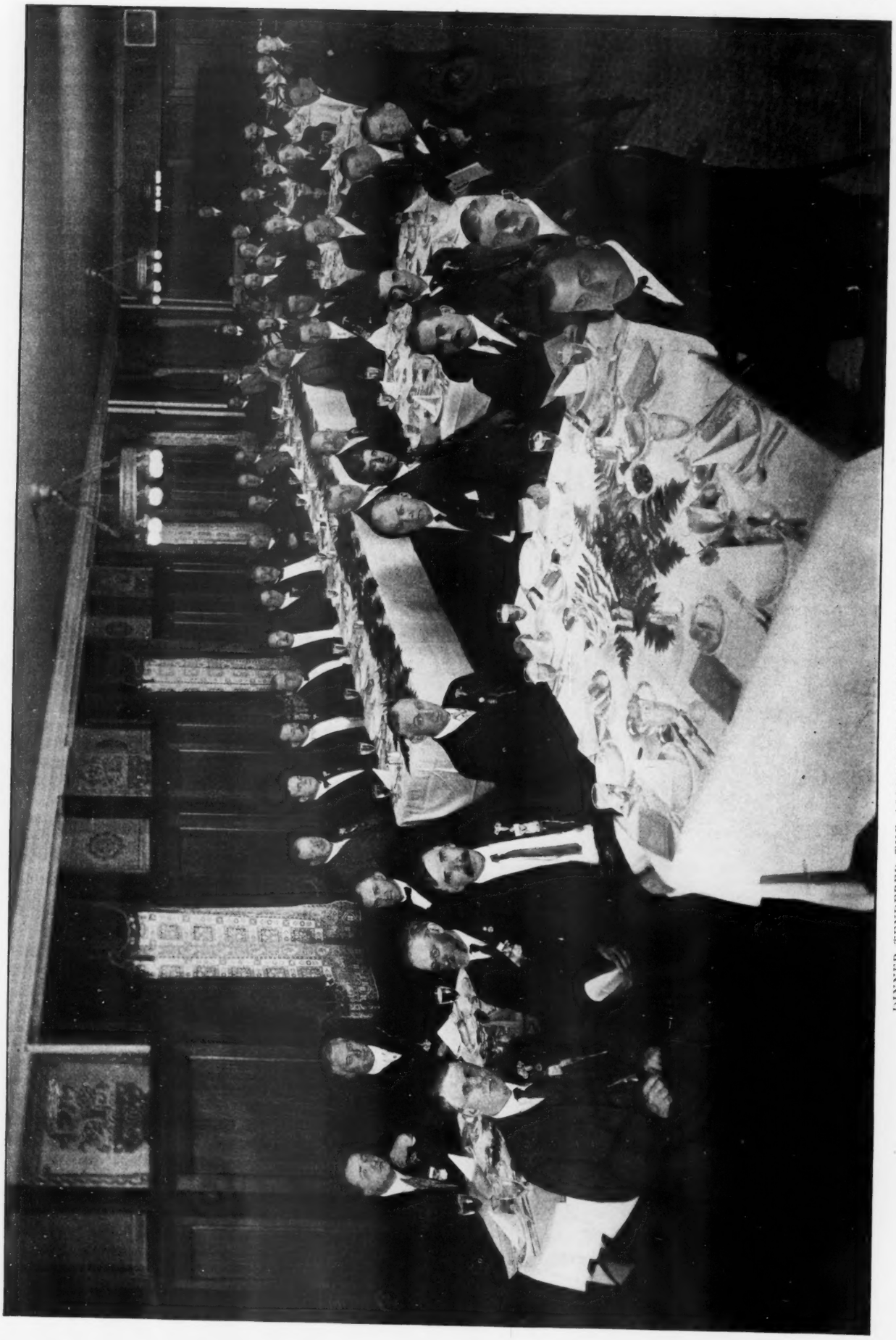
This paper was devoted to a new development in the work of Wentworth Institute, which is directed toward the training of leaders to supply the demand for intelligent, practical executives in the foundry field. The leader in a modern foundry, said the author, has a great variety of responsibilities. His position is a complex one. It includes getting business, managing men, the upkeep of complicated mechanical equipment, the development of better methods of foundry practice, the improvement of quality of product and the lowering of costs. The Wentworth course in foundry practice is planned to cover these points. It is designed to train young men exclusively for the advanced positions in the foundry industry. The instruction includes practical shop experience, text book study, drawing room work, laboratory work, etc., the details of the course being thoroughly covered in the paper.

Thomas D. West, of Cleveland, submitted a paper entitled "Evils Embodied in Specialization."

Miscellaneous Papers

Prominent among the papers presented at the Tuesday afternoon session were two on motor drive and two others on grinding wheels, by H. F. Stratton, S. H. Libby, C. F. Dietz and Clarence Hawke, respectively. Mr. Stratton's paper deals with the economics of electric motor drive.

Mr. Libby's paper on the "Selection of Electric Motors and Controllers for the Foundry," points out that the problem of proper motors and controllers for foundry use must be studied with reference to the selection of alternating or direct current; the type of motor; the type of control and the size of motors. For crane motors direct



DINNER TENDERED THE ASSOCIATED FOUNDRY FOREMEN BY THE CHICAGO COMMITTEE

current is preferable and 230 volts is a desirable pressure if cost of insulation and copper are considered. The speed control of crane motors is important and while a rheostat control is suitable for handling flasks or pig iron, it is not satisfactory in lifting copes, drawing patterns or pouring. Foundry crane motors should handle considerable variations in load with but little change in speed. For general foundry purposes a compound wound motor with a 10 to 15 per cent series field is satisfactory.

Grinding Wheels

The papers on grinding wheels aroused considerable discussion. Mr. Dietz's paper entitled the "Selection of Grinding Wheels for the Foundry" is abstracted as follows:

The development of the modern grinding wheel has been simultaneous with the development of the modern foundry. It would be quite impossible to conceive of a foundry with the melt running into hundreds of tons daily, removing the fins and spurs of its castings by means of a chisel and file. A grinding wheel is both a chisel and file in one instrument, a massive aggregation of little cutting tools bonded together in such a manner that their high speed of rotation provides an opportunity for the rapid and economical removal of large quantities of metal. To get the best results out of grinding wheels great care must be used in selecting a wheel of the proper hardness and with a suitable grain size for the work at hand. The life and productivity of a wheel made of a given abrasive material is directly measured both by the grain size and the strength with which the grains are held together.

This paper includes many suggestions for selecting the proper type of abrasive and the correct grain size and kind of binding for different classes of work. The bond to be used for any given operation depends upon several factors, including the wheel and work speeds, the condition of the grinding machine, the area of the casting in contact with the wheel, the ability of the operator, the character of material being ground and the finish desired. Similar considerations govern the selection of the proper grain size.

A diagram showing the relative efficiency of abrasives of different kinds constitutes one of the important features of this paper. It shows that carbide of silicon is most efficient on materials low in tensile strength, such as cast iron, phosphor-bronze, brass, granite, etc., while alundum has its greatest efficiency on steel, malleable iron, etc.

Mr. Hawke's paper covers the general subject of abrasives, commencing with a definition of abrasion. Such abrasives as emery, corundum, garnet, etc., are discussed, and the manufacture of grinding wheels with natural abrasives is described. In a similar manner the paper takes up artificial abrasives, including silicon-carbide, aluminous abrasives, etc. The paper explains why garnet is particularly valuable for grinding wood. Its scale of hardness lies between 7 and 8 and the crystals are seldom solid. Instead they are fractured along irregular planes which permits the grains to be easily broken down so that sharp cutting edges are always in contact with the fibrous material being ground.

In the discussion of the papers on abrasion, Dudley Shoemaker, of the American Steel Foundries, Indiana Harbor, Ind., asked if there is any known method by which the user of grinding wheels can test them to determine their grade and whether they are hard or soft enough for particular classes of work. Mr. Hawke replied that there is no method of testing wheels except with a chisel and this process requires unusual skill. It was pointed out, however, that the manufacturers of wheels take great care in grading them and under ordinary circumstances the grades can be relied upon. Mr. Hawke also said that an increase of 150 per cent in wheel life is possible through the elimination of unnecessary dressing and proper use of the wheels.

Oxygen in Pig Iron

A paper was presented by J. E. Johnson Jr. pointing out the beneficial effect of oxygen in charcoal iron. The oxygen is introduced into the iron by blowing it in a Bessemer converter. Half a charge is first placed in the converter and blown as cold as possible until the silicon is practically eliminated, the carbon remaining unchanged. As the silicon leaves, oxygen enters and remains in the iron at the comparatively low temperature of the blow. As soon as all the silicon is removed, the remaining half of the charge, which contains twice as much silicon as is desired in the final product, is mixed with the iron in the converter. The details of this process were covered in a paper presented by Mr. Johnson before the American Institute of Mining Engineers last spring. It is claimed that the oxygenized iron has superior qualities and a number of test figures were presented showing tensile strengths of 33,800 to 34,800 pounds per square inch and a transverse strength of 4,505 to 4,875 pounds, using a standard American Society of Testing Materials' 1¼-inch round bar. The bars which were tested analyzed 0.85 per cent combined carbon; 2.65 per cent graphitic carbon; 0.26 per cent manganese; 0.326 per cent phosphorus; 0.039 per cent sulphur and 1.25 per cent silicon. The iron is said to occupy a position in the metallurgical scale midway between malleable and gray iron.

A paper on the selection and use of refractories in the foundry was read by Walter H. Kelley. It stated that a perfect fire clay should analyze 53.27 per cent alumina and 46.73 per cent silica. Fire brick containing from 59 to 73 per cent silica will usually give trouble. Analysis, however, is not the only criterion in judging refractories. Physical structure also must be given consideration, for often the brick is called upon to resist severe abrasion and the scouring action of hot gases moving at high rates of speed.

New Cupola

A paper describing a cupola of new design was presented by G. R. Brandon, of the Whiting Foundry Equipment Co., Harvey, Ill. Two other papers were read at the Tuesday afternoon session, including "Safety First —Driving Back the Saloon", by Thomas D. West, and "The Two-Story Foundry", by G. K. Hooper.

The report of A. O. Backert, secretary-treasurer, is as follows:

Both in prestige and membership the American Foundrymen's Association made big gains during the last year and with a return of trade conditions to normal it is believed that an enrollment of 1,000 can be attained before our next annual meeting. On Sept. 1, the membership reached a total of 807, the high point in the history of the association, and a gain of 92 since July 1, 1913. During the year, 14 members were dropped for non-payment of dues and 12 resigned. An active campaign for new members was conducted during the months of June and July, the results of which were particularly gratifying.

The present secretary-treasurer assumed the duties of his office April 1, 1914, when the records, bound volumes, etc., were turned over to him by the retiring secretary-treasurer, Dr. Richard Moldenke. The records of the office were so well maintained and so complete that no difficulty was experienced in carrying on the work, and therefore no break occurred in the conduct of the affairs of the association while the transfer was being made. Furthermore, Dr. Moldenke co-operated with the secretary-treasurer in every possible way and his unselfish spirit of helpfulness greatly lightened the burdens of the secretarial office.

For the first time in the history of the organization, the secretary was relieved of the tremendous amount of work entailed in securing papers and arranging for the program for the annual meeting. At our last convention, former President H. D. Miles

appointed a committee on papers and program, and the excellent manner in which the work has been done is reflected in the long list of magnificent papers and addresses that are to be presented for your consideration. In this work, J. J. Wilson, of Detroit, chairman, was ably assisted by H. B. Swan, and to promote the interest of some of the world's leading metallurgists in your society, Mr. Swan visited Albany, Boston and New York in his quest for papers from scientists of world-wide fame. This first experiment with a committee on papers certainly warrants its continuation and the gratifying results obtained merit widening the scope of the committee work of the organization.

The affairs of the world's leading technical societies largely are conducted by committees and the number of committees of the American Foundrymen's Association should be greatly increased. In the appointment of members to carry on such work, care should be exercised to localize them as far as possible, thereby reducing traveling and incidental expenses.

Owing to the fact that the duties of the former treasurer were terminated on March 31, 1914, financial statements are shown covering the period from July 1, 1913, to March 31, 1914, and from April 1, 1914, to June 30,1914. The combined statement shows total receipts of $6,391.14 and disbursements of $6,315.31, leaving a balance in the treasury on July 1, of $75.83. The cost of the Transactions was $3,371.05, and it is believed that this expenditure will be greatly increased in the publication of Volume XXIII, as there is every indication that this will contain approximately 800 pages. It, therefore, is absolutely essential that the revenue of the association be greatly increased and the only method by which this can be accomplished at present is by the enrollment of new members.

The secretary's report included the following table showing the growth in the membership of the American Foundrymen's Association since its inception:

Convention number.	Year.	Number of members.	Place of meeting.
1	1896	345	Philadelphia
2	1897	486	Detroit
3	1898	566	Cincinnati
4	1899	310	Pittsburgh
5	1900	341	Chicago
6	1901	297	Buffalo
7	1902	314	Boston
8	1903	317	Milwaukee
9	1904	278	Indianapolis
10	1905	294	New York
11	1906	300	Cleveland
12	1907	532	Philadelphia
13	1908	715	Toronto
14	1909	724	Cincinnati
15	1910	753	Detroit
16	1911	692	Pittsburgh
17	1912	626	Buffalo
18	May 1, '13	715	Chicago
19	Sept.11,'14	825	Chicago

The report of the committee on industrial education, by Paul Kreutzpointer, chairman, stated that six states thus far have inaugurated definite systems for the organization and supervision of industrial schools, including Pennsylvania, Wisconsin, Indiana, Massachusetts, New York and New Jersey. Decided progress has been made in the establishment of numerous corporation schools. The report discusses corporation schools at length, taking up their functions, the subject matter taught and their relation to the public school system. Continuation schools also are considered. The proper courses of study for continuation schools are outlined and the attitude of the school men toward them is discussed.

One entire session, Wednesday afternoon, was given over to malleable foundry problems. It was notable for the number and variety of the papers, the spirit of the discussion and the character of the attendance. The American Foundrymen's Association has held special sessions on steel foundry practice at a number of conventions, but this was the first time similar efforts were made for the malleable foundrymen. The results were gratifying. Prominent malleable men from all parts of the country were on hand and took part in the proceedings. The western section of the American Malleable Castings Association held a meeting in Chicago in the morning and adjourned practically *enmasse* to the Stock Yards Inn in the afternoon.

Calculating Malleable Mixture

"Calculating Mixtures for Malleable Iron", a paper by Harrold Hemenway, Moline, Ill., treats briefly of the elements entering into the manufacture of malleable castings and explained fully a system of calculating mixtures. There are five elements that enter into the composition of malleable iron, two of which are classed as negative and three as positive. The negative elements are sulphur and phosphorus and the positive elements are silicon, carbon and manganese. Of the latter silicon is the one on which the greatest dependence is placed. The method of calculating mixtures which the author explained in considerable detail is simple and easily understood and is applicable to a wide range of conditions. The silicon contents may be easily manipulated and the method is adapted to heats of any size.

A paper on the effect of varying silicon and carbon in malleable mixtures was read by A. L. Pollard. It is published elsewhere in this issue.

An interesting defense of the quality of the inner portions of malleable castings was made by Enrique Touceda in order to refute the statements sometimes made that malleable iron owes its good features entirely to the treatment given the skin. Mr. Touceda made a series of tests on malleable castings as they were received from the foundry and also on castings that had been machined so that all of the outer skin was removed. These tests indicated that the metal in the core of properly made malleable castings is of superior quality and sufficiently ductile for all ordinary purposes.

"Malleable Iron—Its Manufacture, Characteristics and Uses", by J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.

This paper details the early history of malleable iron with particular reference to the growth of this industry in United States. Air furnace practice is described and the difference between the terms "shrinkage" and "contraction" in malleable nomenclature is pointed out. Details are given regarding the annealing process and it is particularly pointed out that heavy sections can be annealed as thoroughly as light ones.

In conclusion, this paper contains the following suggestive paragraphs:

If the consumers of malleable iron castings would co-operate a little more closely with the malleable iron foundrymen in designing their castings, much good would be accomplished, as frequently the failure of malleable iron castings is largely due to their being improperly designed causing shrinkage flaws or undue strains which have weakened the castings. Co-operation of this kind would not only result in better castings but in cheaper ones, as it would in a large measure obviate one of the principal sources of loss in the malleable iron foundry, due to cracked castings, cracking being caused by unequal strains while cooling in the mold.

Instead of getting up elaborate specifications by far the best precaution is to have a test lug cast upon every piece, which can be broken to determine whether the malleable casting is thoroughly annealed without in any way injuring or destroying the efficiency of the casting.

"Researches in the Annealing Process for Malleable Castings," a paper by Oliver W. Storey, is, in abstract, as follows:

From the results obtained by E. L. Leasman and reported at the 1913 meeting of the American Foundrymen's Association in a paper entitled "A Study of the Annealing Process for Malleable Castings," the author has been able to make a more extended investigation of the exact nature of the reactions occuring in the annealing of white iron. The results of this investigation are presented in this paper.

In his work Mr. Leasman investigated the influence of the following variables upon the structure of malleable iron: Packing materials, temperature of annealing, time of annealing and rate of cooling. The results of the more extended investigation made by the author on this subject follow:

1.—The critical range of cooling malleable iron is between 700 and 775 degrees Cent.

2.—Below 700 degrees Cent. no de-

composition of iron carbide occurs.

3.—All malleable iron must be cooled slowly to 700 degrees Cent. to insure a complete breakdown of the iron carbide.

4.—Increasing the percentage of silicon will increase the upper limit, while increasing the manganese will decrease it. In addition to the experiments upon malleable iron, similar experiments were made upon gray cast iron. Similar results were obtained, though the upper temperature limits were higher, probably due to a higher silicon content.

Interesting Discussion

The foregoing papers were discussed in a group. President Howell asked Mr. Pero why malleable is considered superior to gray iron for stove castings. The latter replied that it is preferred on account of its indestructibility and also because it stands heat better without disintegrating, having been annealed at about 900 degrees Cent. Malleable, however, he pointed out, is used principally for the frames, doors, water backs, etc., in stoves.

Mr. Hemenway's method of calculating mixtures was criticized by Enrique Touceda on the ground it is too indirect and complex. J. P. Pero also questioned the value of the method, because it is based entirely on the silicon content without direct reference to the manganese and sulphur, which are important elements. Mr. Hemenway replied that in cases where his calculations are tabulated in the form of heat cards, figuring up a mixture is a very simple problem. He also stated that the manganese and sulphur contents can be properly taken care of by a correct adjustment of the grades of pig iron used.

With further reference to the subjects of manganese and sulphur, another speaker asked, "What are the safe limits of manganese in relation to sulphur for various grades of annealing?" Mr. Touceda replied there must always be a definite relation between these two elements and that the manganese should be kept between 0.2 and 0.35 per cent for satisfactory results. Mr. La Rue stated that a heat in his foundry was ruined by allowing the manganese to rise to 0.60 per cent by mistake. "Good results," he said, "are obtainable with manganese as low as 0.23 and as high as 0.38 per cent, the sulphur being kept under 0.05 per cent."

The same speaker was of the opinion that malleable iron, as a rule, is poured at a lower temperature than gray iron. This view was disputed by Messrs. Pero and Touceda, the latter stating that malleable melts at about 2,350 degrees Fahr., and gray iron at approximately 2,250 degrees. Stanley G. Flagg Jr. said that some tests made of temperatures at the cupola spout with a radiation pyrometer indicated that the gray iron was 300 degrees hotter. Another speaker said that radiation pyrometer readings indicated that castings of the same metal sections were poured at the same temperature, whether gray iron or malleable, namely from 2,400 to 2,600 degrees Fahr. Some doubt was expressed regarding the accuracy of these results owing to the difficulty of making close readings with a radiation pyrometer under certain conditions.

The outstanding feature of the steel foundry session Wednesday morning, presided over by R. A. Bull, senior vice president, was the report of the committee on steel foundry standards. This report is significant not only for its intrinsic value but because it marks the first step in a new policy, namely that of treating subjects of an important nature through committee investigations and reports. The steel foundry standards committee was appointed at the 1913 convention as a result of a paper by R. A. Bull entitled "Some Difficulties in Pouring Steel Castings," and a discussion by John Ploehn, French & Hecht, Davenport, Ia. The committee report is published in full elsewhere in this issue, and the 10 standard nozzle designs are described and illustrated. Upon motion of A. W. Gregg, Bucyrus Co., South Milwaukee, the report was accepted and it was recommended that the members adopt the standard designs for use in their foundries. W. A. Janssen, Bettendorf Co., Davenport, Ia., suggested that stopper rods should be standardized to fit the nozzles. It was pointed out, however, that there is much less variation in stopper rods than in nozzles and no difficulties are expected from this source.

Electric Melting

Electric steel melting received its full share of attention. A paper entitled "The Electric Furnace in the Steel Foundry was read by W. L. Morrison, Welland, Ont., and electric melting also was touched upon by A. F. S. Blackwood in his paper on the melting characteristics of acid steel castings.

In response to a question if electric steel is better than basic open-hearth material of the same analysis, Mr. Morrison replied that it is 25 per cent stronger due to less tendency toward segregation. F. T. Snyder, Metallurgic Engineering Co., Chicago, explained the reason for the superior strength of electric steel in some detail. His explanation was based on the theory that molecules are flat rotating discs, something like poker chips. They have many different axes of rotation under normal conditions. In electric steel, the molecules have a tendency to conform to one dominant plane, and are, therefore, packed together more densely than in ordinary steel. Paul Kreutzpointner, Altoona, Pa., explained the strength of electric steel on the ground of increased density due to the absence of gases and other impurities. Mr. Baldwin stated that in his experience, the tensile strength of electric steel is very little greater than ordinary carbon steel, but the elastic limit is from 60 to 65 per cent greater. G. J. Stock, Darlington, Eng., intended to submit a written discussion but was prevented by the confusion abroad resulting from the war. For a similar reason, Prof. T. A. Louden, Toronto, Can., was unable to complete his paper on making steel direct from ore in the electric furnace. It is probable this will be given next year.

Lining Converters With Ganister

"Ganister Lining in Side Blow Converters, by John Gregson, Sivyer Steel Casting Co., Milwaukee, is abstracted as follows:

The Sivyer Steel Casting Co. has substituted a complete ganister lining for silica brick in its one-ton side-blow converter, with unusual success. The ganister lining has a number of advantages over silica brick. In a one-ton converter the cost of the ganister is about the same as the brick, but there is a big saving of time and material in the daily repairs when the former is used. In one shop where a two-ton converter with a ganister lining is used, an average of eight blows, five days a week, has been maintained for months. It is frequently possible to run an entire week without touching the tuyeres, and no repairs inside the vessel are necessary save small patches on the belly. In a one-ton converter, the same bottom and tuyeres often last four days, with an average of 30 to 36 blows. In addition to explaining the advantages of ganister lining, this paper gives instructions regarding its proper installation in the converter.

In a discussion of this paper, S. D. Sleeth, Westinghouse Air Brake Co., Pittsburgh, asked how much clay is mixed with the ganister as a binder. Mr. Gregson responded that as little as possible is used in order to preserve the refractory qualities of the lining, the proportions ranging from 5 to 10 per cent.

Mr. Blackwoods paper on melting characteristics of acid steel, which was mentioned above, describes the crucible, converter, open-hearth and

electric processes, including details of furnace construction and suggestions regarding the proper manipulation of heats. Many practical suggestions are given in the paper covering the lining of furnaces, charging, tapping, etc. The production of manganese steel is described and various types of side blow converters are discussed. The paper concludes with a resume on electric furnace construction and operation.

Further discussion of electric furnace practice followed the reading of this paper. Mr. Snyder disputed Mr. Blackwood's statement that his furnace is adaptable only for very small units. He said that a furnace built by the Metallurgic Engineering Co., which is now in operation, has a capacity of 190 tons per 24 hours with the melting chamber lined to 6 feet in diameter. The present owner of the furnace has lined it to 5 feet, somewhat reducing the production. Mr. Blackwood inquired how sufficient heat could be obtained to handle such quantities of metal, intimating that most of the heat was produced by radiation from the electrode. Mr. Snyder explained the heat comes primarily from the arc and not from the electrode. The arc, he said, is 14 inches long in the larger furnaces and on account of its length is comparatively cool. This arc partakes somewhat of the nature of the open-hearth flame and a conception of the amount of heat available can be gained from the statement that 800 kilowatts are dissipated in an arc 8 inches long and 2 inches in diameter. This type of arc, Mr. Snyder claimed, reduces the electrode cost and also refractory cost, the latter being from 50 to 60 cents per ton of steel.

Defects in Steel Castings

"Defects in Steel Castings and Remedies for Them," is the title of an exhaustive paper by John Howe Hall, consulting engineer, New York. A. H. Janssen discussed Mr. Hall's paper at length, emphasizing the point that in order to produce good steel it is necessary to use good raw materials and have good iron. He suggested that the American steel makers pay more attention to the quality of scrap and pig iron that they use. He also claimed they are inclined to pour their metal too fast. This results in spongy castings because the mold is not always full when the steel appears in the riser. This is due to the fact that the laws of fluid pressure are operative only as long as steel remains liquid and cease when it becomes plastic, which sometimes happens very soon after it leaves the ladle. Another speaker asked how the multiple gates at different levels, suggested by Mr. Hall, should actually be made. In reply, it was suggested that the gates slope upward so that the metal will not flow through the upper gates until it has reached their level in the mold.

A. F. Stirling Blackwood, Michigan Steel Castings Co., Detroit, said that in considering pipes and other cavities due to contraction, the different conditions surrounding the cooling of castings and ingots should be remembered. In an ingot, segregation results simply from the flow of contraction and is regular in character owing to the regular shape of the ingot. Mr. Blackwood condemned the use of chills against steel castings and was upheld in his contention by John Ploehn, who suggested that the use of chills usually can be avoided by making slight alterations in the pattern.

"Annealing and Heat Treating Steel Castings," by Wm. Campbell, Columbia University, New York City, was read by title.

Gray Iron Session

The final session Thursday afternoon was devoted almost entirely to the discussion of gray iron foundry problems. The principal feature was a paper on "Cast Iron With Unusual Structure," by K. W. Zimmerschied, Detroit, which is published in full in this issue. Great interest was expressed in the extraordinary characteristics of Mr. Zimmerschied's iron. The gist of the rather extended discussion which followed the presentation of the paper by H. B. Swan, was that the iron owed its qualities largely to the high percentage of combined carbon and sulphur. The silicon also is high but the precipitation of graphite which usually acompanies high silicon is prevented by the comparatively large amount of sulphur, this element averaging 0.136 per cent. In response to a question, Mr. Bauer, Rogers, Brown & Co., Chicago, suggested the use of high silicon Bessemer pig iron and high sulphur coke in order to duplicate this iron. This information was supplemented by Mr. Swan, who said that the mixture contained 10 per cent steel scrap. It was pointed out that the iron described by Mr. Zimmerschied cannot be produced cheaply.

Ben. D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland, said too much stress usually is laid on the silicon and sulphur in pig iron without proper regard for the total carbon. He suggested the use of an iron in which the total carbon is high, running 3.75 per cent, the silicon averaging 2 per cent. S. D. Sleeth corroborated Mr. Fuller's remarks and said it was his custom to specify the total carbon in pig iron, allowing the silicon to run down to 1.9 per cent or possibly less.

Coke Recovered from Cupola

"Iron and Its Properties," by Peter F. Blackwood, Michigan Steel Castings Co., Detroit, was read by title, together with two other papers, "Green Sand Cores," by James Mulvay, Troy, N. Y., and "Coke Recovered from the Cupola Dump," by W. J. Keep, Detroit. The abstract of the latter paper is as follows:

It was found that when coke is only partially burned, the combined portion is higher in ash and lower in sulphur than the original coke. The ash, if undisturbed, will not fall off while the coke burns. Only 1 per cent of the sulphur in the coke remains in the ash, the rest passing off in gas. Whether any of the sulphur is absorbed by the iron and if so, what amount, can best be determined by work on a cupola in actual operation. This paper originally was submitted for publication in THE FOUNDRY, but owing to the importance of the results obtained, it was concluded to first present it to the American Foundrymen's Association.

Paul Kreutzpointner, Altoona, Pa., presented a report on his participation in the Fifth Annual Conservation Congress, Washington, Nov. 18-20, 1913, where he represented the American Foundrymen's Association.

"A Memorandum on the Preparation of Standard Specifications for Cast Iron for International Export Use", by Dr. Richard Moldenke, Watchung, N. J., is abstracted as follows:

The author describes the first actual progress made in the preparation of international standard export specifications. Thus far all efforts failed because an effort was made to bring the standard specifications of each of the interested countries into line, particularly so far as steel was concerned, the different methods of preparing materials, governmental control of transportation, etc., and particularly the tender care exhibited for invested capital on the part of foreign nations. This made it most difficult to secure harmony of action to date.

The paper gives the history of the situation for pig iron, cast iron pipe and the international test bar for valuing castings for export. It describes the bringing about of definite proposals by the International Committee and the prospect of final action at the coming St. Petersburg Congress of the International Association for Testing Materials, to be held in August, 1915.

In discussing this memorandum,

Mr. Hopkins, of the United States Cast Iron Pipe & Foundry Co., read a letter from a representative of the English cast iron pipe makers stating that the international specifications which have been proposed are not satisfactory. Hr. Hopkins also stated that the American manufacturers are not in sympathy with the European method of increasing the strength of the pipe by reducing the inside diameter, maintaining the outside diameter constant. It is said this would compel manufacturers in this country to carry too many sizes of core bars.

Election of Officers

The annual business meeting and election of officers took place at the La Salle hotel, Friday morning, and the following officers were unanimously elected for the ensuing year: R. A. Bull, Commonwealth Steel Co., Granite City, Ill., president; H. E. Field, Wheeling Mold & Foundry Co., Wheeling, W. Va., senior vice president; A. O. Backert, THE FOUNDRY, Cleveland, secretary-treasurer; Henry A. Carpenter, General Fire Extinguisher Co., Providence, R. I., Walter Wood, R. D. Wood & Co., Philadelphia, S. B. Chadsey, Massey-Harris Co., Ltd., Toronto, Ont., T. W. Sheriffs, Sheriffs Mfg. Co., Milwaukee, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill., Alexander T. Drysdale, Sheffield Cast Iron Pipe & Foundry Co., Sheffield, Ala., J. J. Wilson, Cadillac Motor Car Co., Detroit, A. H. Thomas, Buckeye Steel Castings Co., Columbus, and Ben D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland, O., vice presidents.

Before retiring, President Howell announced the following standing committees for the ensuing year:

Papers.—H. R. Swan, Cadillac Motor Car Co., Detroit, chairman; A. O. Backert, THE FOUNDRY, Cleveland; S. B. Chadsey, Massey-Harris Co., Ltd., Toronto, Ont.; John Howe Hall, consulting engineer, New York City; J. P. Pero Jr., Franklin Park Foundry Co., Franklin Park, Ill.: D. W. Sowers, Sowers Mfg. Co., Kokomo, Ind.; O. J. Abell, *Iron Age*, Chicago.

Steel Foundry Standards.—Dudley Shoemaker, American Steel Foundries, Indiana Harbor, Ind., chairman; A. H. Janssen, Bettendorf Co., Davenport, Ia.; Ralph H. West, West Steel Castings Co., Cleveland; L. A. Way, Duquesne Steel Casting Co., Coraopolis, Pa.; A. H. Thomas, Buckeye Steel Castings Co., Columbus, O.; A. F. Stirling Blackwood, Michigan Steel Castings Co., Detroit.

Specifications for Foundry Scrap.—S. D. Sleeth, Westinghouse Air Brake Co., Pittsburgh, chairman; Alex W. Thomson, H. W. Caldwell & Sons Co., Chicago; W. J. Keep, Detroit; H. Cole Estep, *The Iron Trade Review*, Cleveland.

Safety and Sanitation. — A. W. Gregg, Bucyrus Co., South Milwaukee, chairman; Thomas D. West, West Steel Castings Co., Cleveland; F. H. Elam, American Steel Foundries, Chicago; Arthur T. Morey, Commonwealth Steel Co., Granite City, Ill.; M. W. Alexander, General Electric Co., West Lynn, Mass.

Costs. — Ben D. Fuller, Westinghouse Electric & Mfg. Co., Cleveland, chairman; B. J. Walker, Erie Malleable Iron Co., Erie, Pa.; H. O. Lange, Ferguson & Lange Foundry Co., Chicago; E. G. Felthausen, Acme Steel & Malleable Iron Co., Buffalo, N. Y.; Harrington Emerson, Emerson Co., New York City.

Committee to Work in Conjunction With American Society for Testing Materials on Specifications.— (1) *Gray Iron,* J. J. Wilson, Cadillac Motor Car Co., Detroit; W. P. Putman, Detroit, and Richard Moldenke, Watchung, N. J. (2) *Steel*—R. A. Bull, Granite City, Ill.; W. C. Hamilton, American Steel Foundries, and W. G. Nichols, Edgar Allen American Manganese Steel Co., Chicago. (3) *Malleable* — Enrique Touceda, Albany, N. Y.; A. H. Jameson, Malleable Iron & Fitting Co., Branford, Conn., and F. E. Nulsen, Missouri Malleable Iron Co., East St. Louis, Ill.

Industrial Education. — Frank W. Leavitt, University of Chicago, Chicago, chairman; Dean Connelly, Carnegie Institute, Pittsburgh; Dean Snyder, State Commissioner of Education, New York City; C. E. Hoyt, Lewis Institute, Chicago; Edward A. Johnson, Wentworth Institute, Boston; Paul Kreutzpointner, Altoona, Pa.

Committee on International Meeting 1915.—Richard Moldenke, Watchung, N. J., chairman; Walter Wood, R. D. Wood & Co., Philadelphia; Thos. W. Devlin, Devlin Mfg. Co., Philadelphia.

Constitution Amended

The report of the special committee to amend the constitution was presented at the Friday morning session and adopted. The amendments will be submitted to the membership for letter ballot. The principal change provides for associate membership with annual dues at $5 per year, to which persons engaged in foundry work such as foremen, or firms and corporations having a commercial interest in foundry operations but not engaged in the production of castings are eligible. Employes of such firms also are eligible. A provision was adopted to charge an initiation fee of $5 for both classes of membership commencing May 1, 1915. The customary resolutions of thanks were adopted and the auditing committee reported that the books of the treasurer are in good shape. In accordance with the usual custom, Alfred E. Howell, the retiring president, was elected an honorary member. John A. Penton, the first secretary of the association, also was elected an honorary member.

Entertainment Features

Chicago maintained its reputation for abundant hospitality and an enjoyable entertainment program was provided. A boat ride, which included music and dancing, was tendered the visiting foundrymen on Tuesday evening The ladies enjoyed a luncheon at Stock Yards Inn on Wednesday and also a banquet at La Salle hotel, Thursday evening. The Chicago Association of Commerce provided a special train which visited points of interest throughout the city on Friday afternoon.

The annual convention banquet was held Thursday evening at the La Salle hotel. H. O. Lange acted as toastmaster. Remarks were made by Alfred E. Howell, president, American Foundrymen's Association, and G. H. Clamer, president, American Institute of Metals. An address entitled "Some By-products of Commerce and Industry," was made by Dr. James H. Kirkland, chancellor, Vanderbilt University, Nashville, Tenn.

The Associated Foundry Foremen were tendered a banquet by the local committee on Monday evening, at which H. O. Lange presided. This association also held a meeting Thursday morning, at which a paper on the application of geometry to foundry work was presented and the following officers were elected for the ensuing year: Robert MacDonald, Samuel Moore & Sons Corporation, Elizabeth, N. J., president; J. A. Laucke, S. J. Gresswell Co., Philadelphia, Pa., vice president; Robert B. Thompson, 78 Verplanck street, Buffalo, secretary-treasurer.

Requests Catalogs

The St. Louis Smelting & Refining Co., whose purchasing department and general offices are located in St. Louis, is revising its catalog files at its mines and smelter and would like to receive catalogs, price lists, etc. from manufacturers and jobbers supplying this trade. Copies of catalogs, etc. should be sent to the St. Louis Smelting & Refining Co., St. Francois, Mo., and to the St. Louis Smelting & Refining Co., Collinsville, Ill.

Safety and Sanitation in the Brass Foundry

How a Large Car Building Company Protects Its Workers from Injury and Occupational Disease

By Fred Moerl

FEW topics have commanded the attention of those engaged in the manufacture of brass products for the last two or three years, more than that of sanitation and safety first, and it is only fitting that this subject should receive due consideration. Nearly every issue of our various trade journals contains articles treating on the subject, enlightening us as to what has been and what can be done in improving present conditions. The laws written on the statute books of the different states, as well as the compliance therewith and the voluntary application of safety devices, and adoption of sanitary measures on the part of the shop managements, are for the purpose of improving the welfare and conditions of working men.

And while it may appear that great sums of money are spent these days in this safety work with no direct cash returns in carefully scrutinizing results, we will find it not alone one of humanity, but also one of economy. For instance, a man working on a certain machine is injured and incapacitated for a week or two, which may require the machine to stand idle, or as is usually the case, the injured man is replaced temporarily by one not so familiar with that particular job. Consequently the output will not come up to the usual quality or quantity, which means a financial loss to the firm. How much better a man can work in a clean, well-lighted and well-ventilated foundry or finishing shop than in one presenting opposite conditions, is well known.

At the Buffalo convention of the American Institute of Metals, in 1912, Dr. Charles L. Parsons, representing the United States government Bureau of Mines, brought up the subject of health conditions in brass foundries, and the discussion which followed demonstrated that many of those present were keenly interested in this problem of conserving human energy, and that several of the industries represented had already installed shower baths and other sanitary equipment.

July 1, 1911, the occupational disease law became effective in the state of Illinois, and at first the attitude of many of both employers and employes, was more or less hostile throughout the state. Some employers, considering it a new-fangled fad, reluctantly complied with provisions of the law and then only to such extent as to be within its absolute requirements. Others willingly and cheerfully installed the necessary equipment, and even went beyond that which was expected of them in providing safety and sanitary measures.

On the other hand, the men did not unanimously welcome the law as one made primarily for their welfare, and displayed more or less antagonism. They regarded the compulsory compliance on their part as an encroachment upon their personal liberties. At the Pullman Co.'s plant, Pullman, Ill., these conditions have been practically overcome, and what is now commonly known as the "Safety First" movement is being more and more advanced by both management and employes.

In patent medicine advertisements we sometimes see an illustration of a person before and after using the highly recommended "cure-all-and-heal-over", and in recalling the sights while witnessing the earlier medical examination, and again those following a month or two later, we were vividly reminded of these ads. This refers to general personal appearance and cleanliness, particularly the teeth. The bad condition of the latter was astounding, and nearly every other examination resulted in the doctor's order, "Clean your teeth".

As my duties require the supervision of the manufacture of trimmings for approximately 2,000 cars a year, taking in not only Pullman, but also various contract cars for the different rail-

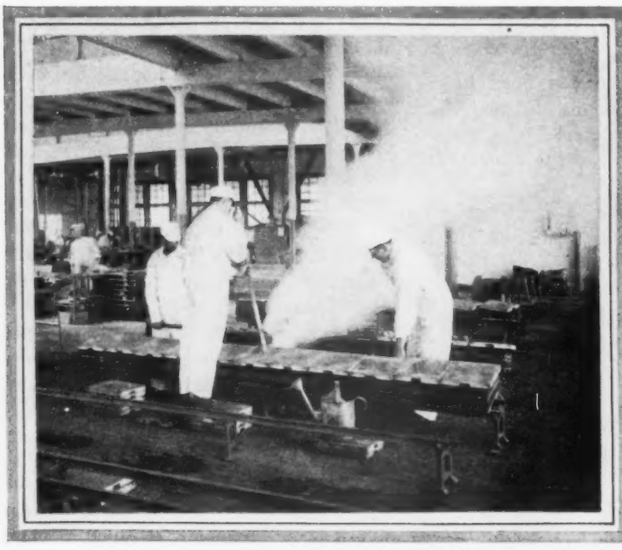


FIG. 1—POURING BRASS AT PULLMAN WORKS—THE MEN ARE ALL CLOTHED IN WHITE

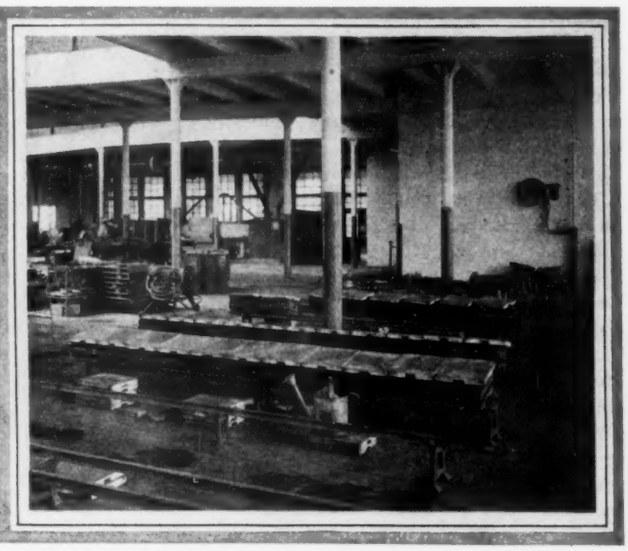


FIG. 2—THE SAME ROOM 30 SECONDS AFTER POURING, SHOWING EFFECT OF GOOD VENTILATION

A paper read at a joint meeting of the American Foundrymen's Association and the American Institute of Metals at Chicago, Sept. 8, 1914. The author, Fred Moerl, has charge of the foundries of the Pullman Co. at Chicago.

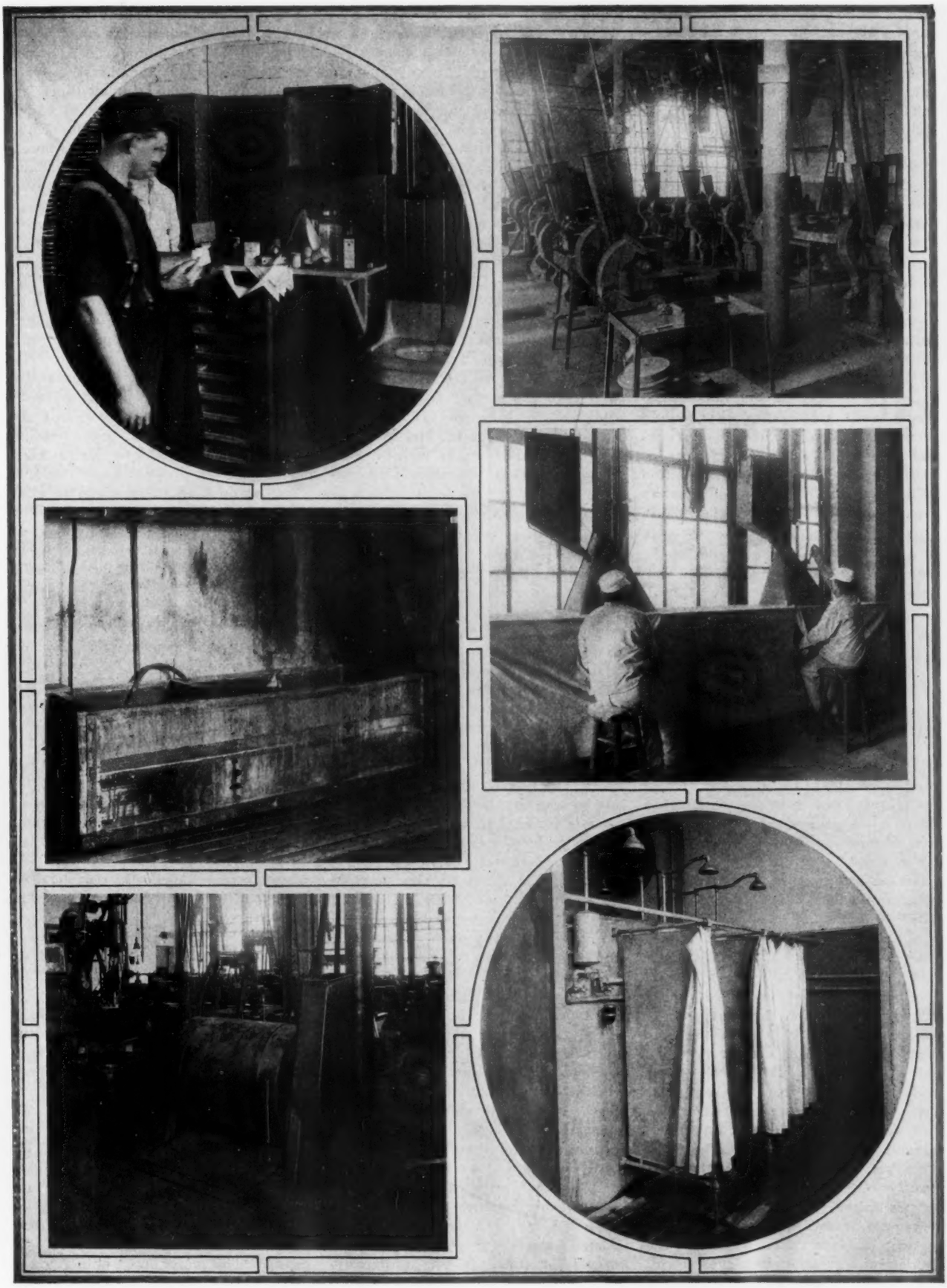


FIG. 3—FIRST AID CABINET IN WASH ROOM

FIG. 4—POLISHING WHEELS FITTED WITH DUST EXHAUST HOODS AND BELT GUARD

FIG. 5—EXHAUST FAN CONNECTION OVER DIPPING TANK

FIG. 6—SAND BLASTING UNDER A PROTECTING HOOD

FIG. 7—TUMBLER FOR BRASS CASTINGS FITTED WITH BELT GUARD

FIG. 8—THE MEN USE THE SHOWER BATH ON THE COMPANY'S TIME

roads throughout the country, my observations of the safety work are practically limited to the brass department, and outside of that, I can speak only in a general way.

That portion of the work at the Pullman plant directly affected by the Illinois occupational disease act, is in charge of the safety department chief clerk, and it is his duty to supervise and regulate the medical examinations, baths, changing of overalls, jumpers, towels, etc., making proper entries on forms gotten up for that purpose. Molders, grinders, coremakers, melters, in fact all brass foundry employes, including the office force, polishers, buffers, platers, painters, glaziers and sand blasters, come under the supervision of this end of the department.

The safety engineer investigates and recommends relative to the compliance with federal, state and city laws and ordinances regarding matters of sanitation, buildings and prevention of accidents. This end of the safety department takes in the entire plant.

Before we can put a man to work at any of the named occupations, he must first undergo a medical examination, made by the company's physician, who reports on a regular form as to the applicant's health. When the application has been approved, the man may be put to work, but before commencing, the safety department furnishes him with a pair of white overalls and jumper, towels, nail brush and, if necessary, goggles, respirator, rubber gloves or rubber apron. The goggles are supplied to grinders; rubber gloves and respirators to sand blasters. A proper record is kept of this transaction, and when leaving the company's service these articles must be returned to the safety department, where they are properly sterilized. Suitable shower baths are installed, and it becomes obligatory on the man's part to take a shower bath at least once a week, a certain time being allotted each department or part thereof for that purpose.

One-half hour is allowed by the management for each man every week, and no deduction of time is made while taking the bath. Once, and some cases, twice every week, he turns in his soiled overalls and jumper, and is furnished a freshly laundered set. The towels are also frequently changed the same way, and the respirators cleaned and sterilized at regular intervals.

Each employe coming under the regulations of the safety department, is allotted a two-compartment steel locker, equipped with a small mirror, proper shelving and suitable coat and hat hooks. Locks are fitted to individual keys; the keys are fastened to a key ring, together with the employes' gate house brass check. The lockers are divided into an upper and lower compartment; the upper for the street clothes, and the lower for the shop wearing apparel, and are so located in the different wash-rooms as to allow sufficient room for changing from street to shop clothes, or vice versa. The wash rooms are equipped with long, and in some cases, individual wash-basins. The large ones have a number of faucets with running water, the latter being properly mixed to a suitable temperature in an adjacent large tank. Liquid soap containers are placed at regular intervals. Ten minutes prior to quitting time, these wash rooms are opened to the men to wash in and change clothes, and by the time the whistle blows they are all cleaned up, and in leaving the works many might well be taken as belonging to the office force.

Medical Examination Once a Month

Every employe in the brass foundry and finishing department must undergo a medical examination once every month, and if found affected with plumbism, or any disease peculiar to the trade at which he is working, he is most closely scrutinized with a view of overcoming the cause of the ailment, which usually results in the correction of some slight improper practice, and the consequent disappearance of symptoms. In the more severe cases and those where no correction can be made, other employment is found, but even then the case is kept under the doctor's surveillance until complete recovery.

One of the great problems in the brass foundry and brass finishing shop, is that of ventilation. While the construction of some of the older buildings is such as to necessitate artificial means of removing fumes and foul air, yet buildings of more modern types are, or should be, so designed as to insure natural ventilation by providing sufficient windows and skylights, which can be easily and quickly opened and closed. In summertime this will work out without any great difficulties, but in cold weather we find that the men object more or less to the opening of the windows, and some would rather inhale the metal fumes. In such cases we found that the factory inspector insisted upon opening everything during pouring time. In the accompanying illustrations will be found reproductions of two photographs. One picture was taken while pouring, and the other was snapped in the same position as soon as the smoke had cleared away, which was only 30 seconds.

The floors in the brass foundry should be kept moist at all times, and one of the laborers delegated to liberally use the sprinkling can. Under no circumstances should any one be allowed to eat lunch in the foundry, polishing or plating rooms, and suitable places should be provided for that purpose. The Pullman car works was one of the first shops to meet all and even went beyond the requirements of the occupational disease act, and the management is willing at all times to consider any new safe-guarding device, or suggestions of health measures.

The emery wheel exhaust heads and guards were designed and made in our own plant. The exhaust heads are made of ⅛-inch sheet iron, and the guard bands of ¼-inch boiler plate, assembled by oxy-acetylene welding. The whole head is arranged to slide, so as to take up for the wear of the wheel. The lower portion of guard front can be adjusted so as to close off that part of wheel not in use. The lid for removing the wheel is hinged, and when closed is fastened by a catch, as well as a bolt and nut, serving as stress members in case the wheel bursts.

Our shower baths are equipped with a mixing tank, which is supplied with hot and cold water, regulating it to a suitable temperature. They are grouped in sets of seven, each again sub-divided by canvas curtains, for the individual bath. Vapors are drawn out by large, natural draft ventilators, placed in ceiling or side wall.

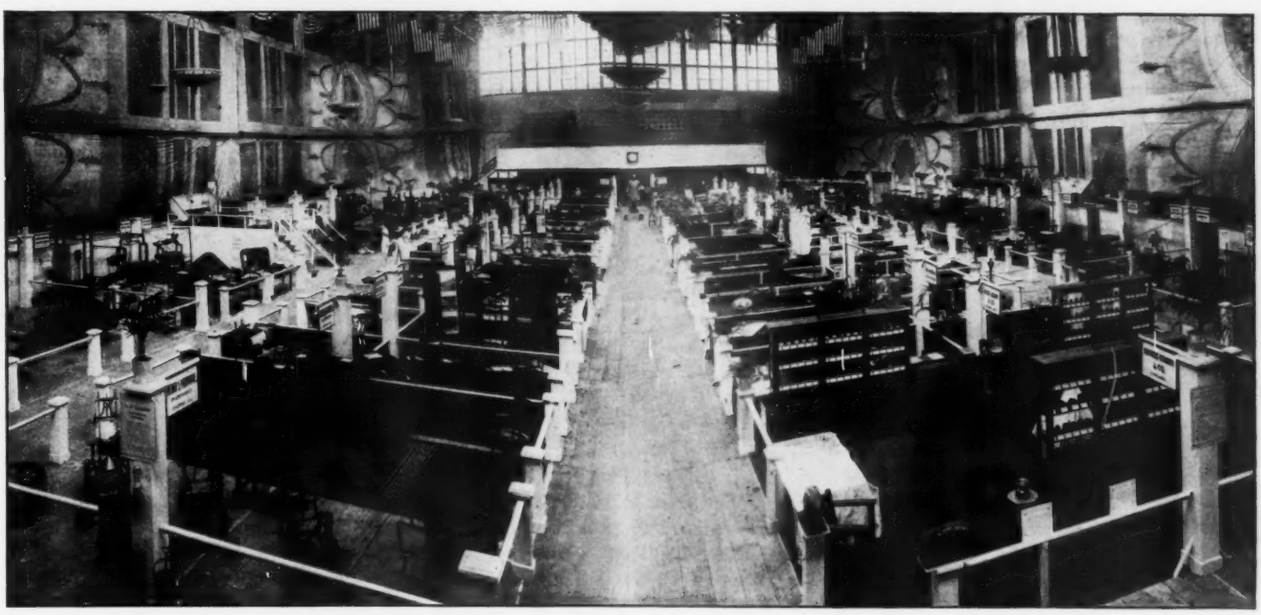
We have 28 "First Aid" cabinets placed around the different departments of the works, and about 70 men are trained to do first aid work. The first surgical attention is received in the "first aid" room, and in case of fracture the X-ray apparatus is used for determining the mode of procedure. Photographs are taken of all fractures. While we term it the "first aid" room, the equipment and facilities are sufficient for handling any minor or more serious operations.

To clear a dipping room from the obnoxious acid fumes is a difficult task. After trying out various schemes and ventilating systems, we found an 18-inch wall type fan run at 1,700 revolutions per minute direct-connected to a motor, the most effective. The motor must be either encased or the fan shaft extended into the next room and there connected. Guards completely enclose the tumbling barrels and also the belts.

Great Display of Foundry and Shop Equipment

Foundry and Machine Exhibition at International Amphitheatre Attracts Many Visitors and Stimulates Business

IN character of displays, number of exhibitors, and quality of attendance, the ninth annual exhibition of foundry and shop equipment which was held in Chicago, Sept. 5-11, concurrent with the conventions of the allied foundry associations, maintained the high standard that had been set in previous years. There were over 155 exhibitors and the great arena of the International Amphitheatre, one of the largest exhibition buildings in the world, was crowded with the most up-to-date products of America's metal working establishments. More than the usual proportion of presidents, managers and other executives occupying important positions was found among those in attendance and consequently the purchasing power of the visitors was above the average.



MAIN ARENA AT FOUNDRY AND MACHINE EXHIBITION LOOKING EAST

A survey of the show as a whole gives a picture of the advances of the past 12 months in the foundry and machine shop fields. Although the exhibits contained little that was radically new or that gave promise of being revolutionary, the past year has been by no means devoid of progress. There is a steady, presistent pressure to eliminate all hand-labor operations as fast as possible in all branches of manufacture, and considerable ground has been gained along this line recently. In the molding machine field, manual dexterity has been all but totally supplanted by mechanical accuracy; in handling materials, preparing or mixing sand or cleaning castings, machines are becoming more numerous every month, while in the machine shop all operations are rapidly approaching the automatic stage. The principal advances in molding machine construction during the past year have come through combinations of machines which perform elementary operations, resulting in devices that handle all of the operation connected with making a mold instead of only a portion of them. This tendency, which first became noticeable at the exhibition in 1913, has been more pronounced during the past year than ever before. Machines are now being built which employ two or more kinds of motive power including both compressed air and electricity. It is becoming evident that instead of electricity supplanting compressed air in foundry work, particularly in connection with molding machines, these two sources of power will supplement each other and will be equally important in the foundry of the future.

A standard type automatic molding machine was one of the chief features of the display of the Berkshire Mfg. Co., Cleveland. This machine not only performs molding operations, but riddles and handles the sand, being equipped with suitable elevators, hoppers, sifting devices, etc. Air and hand squeezer machines similar to those installed in the plant of the Ford Motor Co., at Detroit, were displayed together with core machines, vibrators, special flasks, etc.

The exhibit of Henry E. Pridmore, Chicago, included stripping plate and rock-over drop machines; power squeezers; plain electric driven jarring; combination electric jolt rock-over drop; electric jolt stripping plate; power ramming stripping plate; hand squeezers; plain stripping plate and power rock-over stripping machines. These machines as usual were shown in operation making molds for the visiting foundrymen. The feature of the exhibit was the combination electric jolt and power rock-over drop machine, which was described in the September, 1914, issue of THE FOUNDRY. This machine is built in several sizes, the one shown at the International Amphitheatre having sufficient capacity for handling molds weighing up to one ton. The machine performs all of the operations in connection with making molds and utilizes both electric and pneumatic power.

An important machine of a new type combining jar ramming, roll-over and a pattern-drawing operation was displayed by the Arcade Mfg. Co., Freeport, Ill. Simplicity was one of the aims of the designer of this machine. It has but two cylinders and one valve controlling all movements. Standard squeezer machines also were displayed with extension frames which enable them to straddle wide sand

heaps. In addition, the Arcade Mfg. Co. exhibited brake shoe machines, piston machines, Norcross jarring machines in various sizes, squeezers, core roll-over machines, midget core jolters, sand sifters, etc. The Brillion pouring device, described in THE FOUNDRY, April, 1914, was displayed in the Arcade booth.

Further examples of the prevailing tendency toward combination machines was found in the exhibit of the Buch Foundry Equipment Co., Bridgeport, Pa. A combination twin jar, squeeze and roll-over machine operated by electricity was displayed. It has two jarring machines, combination jar ramming turn-over draw machines, power turn-over power draft machines, stripping plate machines, stationary and portable power squeezers, combination jolt squeezers and core machines. A combination turn-over draw and jar ramming machine, similar to the one described in THE FOUNDRY, September, 1914, was displayed. In this machine compressed air is used exclusively. One of these machines recently was installed in a heating apparatus foundry where it is used for molding 38-inch round sections. The output is said to be 35 flasks in four hours using three

Plain jolt machines, combination jolt and squeezer machines and jolt roll-over direct draw machines were displayed by the Federal Foundry Supply Co., Cleveland. The roll over operation on the latter machine is performed by hand which simplifies the mechanism. The jolt cylinders are of valveless type, and are used for drawing the pattern. Dearsly stripping molding machines and three part combination machines specially designed for intricate automobile and agricultural work were displayed by S. Freeman & Sons Mfg. Co., Racine, Wis.

A tremendous jar-ram molding ma-

NORTH WING, SHOWING EXHIBITS OF SAND HANDLI

jolt platforms which operate under a single squeezer head thus making it possible to mold both cope and drag at the same time. The squeezing operations may be performed either by hand or pneumatically and on the smaller machines the jolting mechanism is operated by a hand lever working in conjunction with a special spring arrangement. Rectangular and round tapered aluminum snap flasks, bottom plates, pattern frames and boards, adjustable steel flask bars, ladles, etc., also were included in the Buch display.

The International Molding Machine Co., Chicago, showed air and electric men; when the same pattern was molded on the floor, three molders put up only 24 flasks in a whole day. Core molding machines of various designs constituted one of the important features of the International exhibit.

An automatic machine for molding stove plate and similar classes of work was displayed by Wm. Demmler & Bros., Kewanee, Ill. It includes sand elevating and handling apparatus, together with the flask carrier and automatic rammers operated by cams. The Hewlett-Demmler core machine also was exhibited. This machine was described in THE FOUNDRY, March, 1912.

chine with independent roll-over and pattern-drawing devices was shown by the Herman Pneumatic Machine Co., Zelienople, Pa. This machine is designed specially for handling exceptionally large molds and a crane is provided for transferring the flasks to and from the table. The general features of the machine are well known and need no extended description. In addition the Herman company displayed jar-ram strippers, plain bumpers, combination jarring and hand stripping machines.

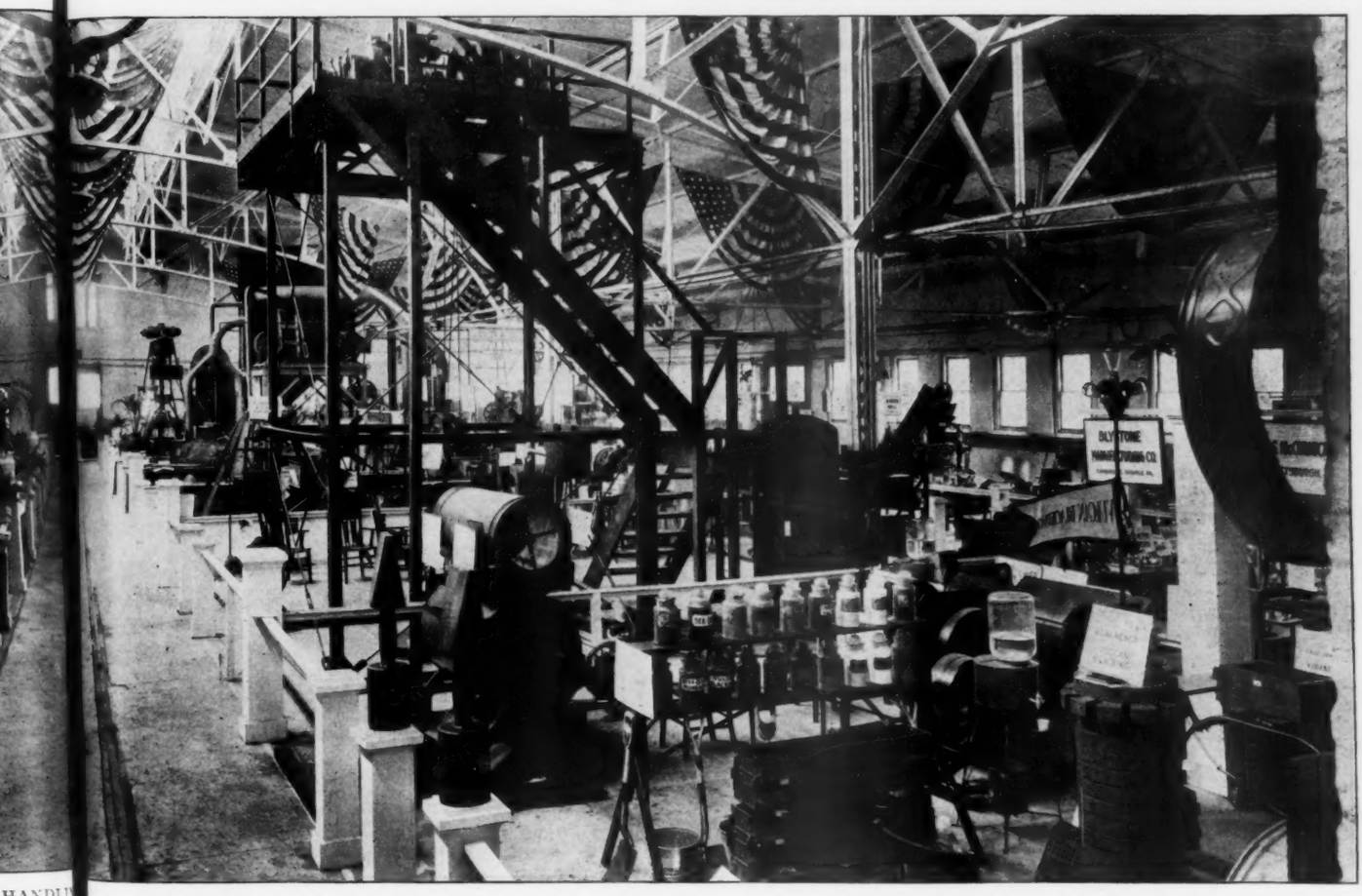
Grimes jolt roll-over molding machines and plain roll-over machines

were displayed by the Midland Machine Co., Detroit.

An exceedingly interesting model showing a full sized vertical cross section of a pneumatic jolt ramming machine in operation was displayed by the Mumford Molding Machine Co., Chicago. This model was elevated so that it was visible from all parts of the arena. The valve was painted red and its action was very clearly delineated. Mumford jolt rammers are now manufactured with a pattern-drawing device which was exhibited and in addition, electric jolt rammers, high trunnion plain power squeezer, combination jolt with power squeezers, combination jar-ram squeezers, split pattern machines and combination squeezer and roll-over machines. A molding machine also was displayed by the Speeder Molding Machine Co., Rockford, Ill.

Practically all of the molding machine manufacturers mentioned showed numerous core making machines of various standard types and in addition the Brown Specialty Machinery Co., Chicago, displayed its Hammer core machines which are designed to make round, square and irregularly-shaped cores continuously. Core cutting off and tapering machines also etc., also was displayed. The two melting chambers of this furnace are mounted in tandem on a single base and the flame enters at the one end. In this way a melting heat is maintained in one chamber and a pre-heating temperature in the other. When the charge in the melting chamber is ready to pour, the direction of the flame is reversed and the preheating chamber becomes the melting chamber. The Monarch company also displayed stationary melting furnaces, ladle heaters, kerosene and fuel oil torches and core ovens.

The Whiting Foundry Equipment



PARATUS, CRANES, TROLLEYS, WELDING DEVICES, ETC.

and squeezer and combination jolt and split pattern vibrator machines were shown.

The Osborn Mfg. Co., Cleveland, exhibited plain jolt machines; direct draw roll-over machines with and without jolting attachments; squeezers, both plain and combination; rock-over jolt, power draft machines, etc. The hand operated, direct draw roll-over machines which were on exhibition were similar to those used in the Ford Motor Co.'s plant for molding cylinders as described in THE FOUNDRY, September, 1914.

The Tabor line was well represented were shown by the Brown company. The S. Obermayer Co., Chicago, showed a core jarring machine of interesting design.

The exhibits of melting equipment were confined mostly to furnaces for brass and other non-ferrous metals. A particularly complete display of apparatus of this character was presented by the Monarch Engineering & Mfg. Co., Baltimore. It included a new oil-fired, reverberatory refining furnace of the tilting type designed to handle 1,700-pound charges. A twin tilting furnace for melting brass, Co., Harvey, Ill., showed drawings of a new type of cupola designed especially for large heats of long duration. This cupola is provided with individual blast boxes instead of the usual wind belt around the tuyeres. Chas. J. Clark, Chicago, displayed the Clark blast meter which measures the volume of air entering the cupola or air furnace.

An unusually interesting exhibit of apparatus for handling materials was made by the Coburn Trolley Track Mfg. Co., Holyoke, Mass. Two different types of overhead monorails were

shown together with a large number of motion pictures illustrating their application. The two types of monorails included the regulation I-beam form and a special rolled section which was shaped so that the load is suspended between the trolley wheels. Interesting types of switches, turntables, etc., for monorails were shown.

A five-ton two-motor electric crane trolley was shown in operation by the Whiting Foundry Equipment Co., Harvey, Ill. This trolley was driven by three-phase, 60-cycle, 220-volt current. The Cowan Truck Co., Holyoke, Mass., showed a storage battery truck provided with a lifting platform which enables it to pick up its load from the floor.

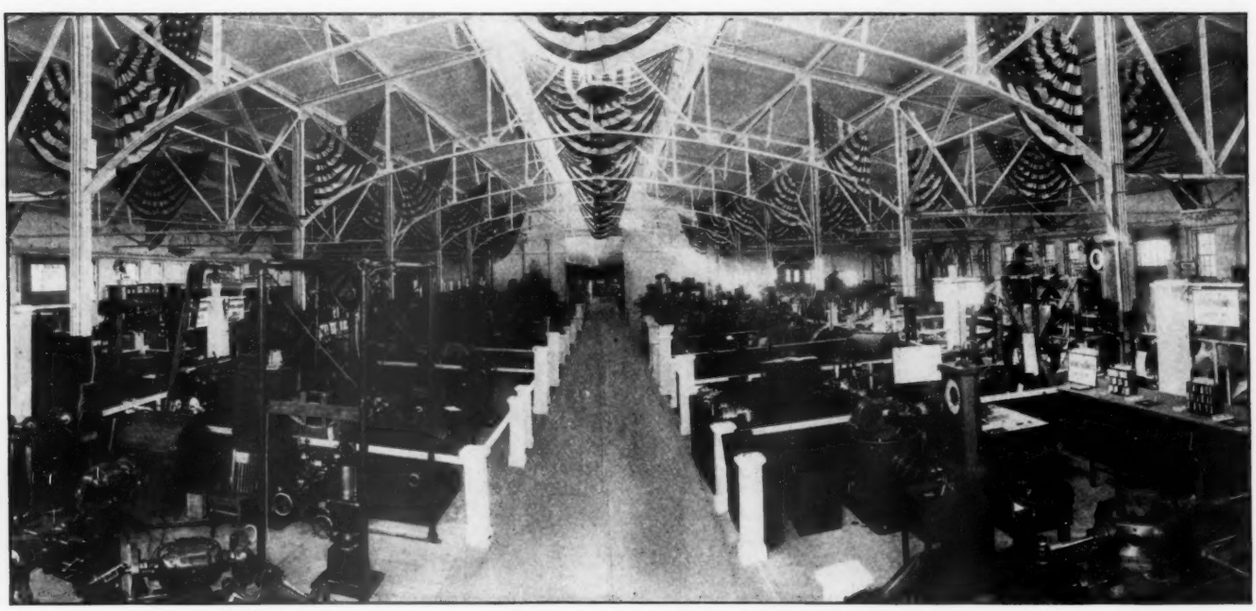
A complete overhead trolley system including main and divergent tracks, switches, etc., and a foundry crane etc., from one department to another, a one ton floor controlled high lift hoist, a one ton floor controlled alternating current hoist, a 5-ton traveling crane trolley and a back-geared motor provided with a winch head. The latter device can be used for hauling core trucks and smaller work where hand labor usually is employed.

Cleaning Room Equipment

Rapid advances have been made during the past year in the design of cleaning room equipment particularly sand blast apparatus. Completely automatic, continuous, self-contained sand blast plants are now offered by a number of manufacturers and where large quantities of comparatively small castings are to be handled these machines eliminate nearly all of the labor in the cleaning room. The W. W. Sly Mfg. Co., Cleveland, showed a new double-acting sand blast machine in operation. It is provided with an oscillating table on which the work is placed and is so arranged that the castings may be passed as many times under the cleaning nozzles as may be necessary for a thorough job. Both ends of the oscillating table project from the machine and the castings may be loaded and unloaded from either end. In addition the Sly company showed an automatic rotary sand blast table machine, sand blast barrels, tumbling mills, dust arresters, etc., in operation. Duplex shakers driven both by air and electricity and electric Simplex shakers were shown by the Brown Specialty Machinery Co., Chicago.

The Central Iron Works, Quincy, Ill., exhibited photographs and drawings of improved tumbling mills, water cinder mills, dust arresters, sand separators, sand blast machines and other cleaning room and core equipment. The Curtis Pneumatic Machinery Co., St. Louis, Mo., displayed two types of sand blast apparatus and also two types of air compressors. The Knickerbocker Co., Jackson, Mich., displayed Morse rarefied dust collectors. Cleaning room equipment also was shown by the Macleod Co., Cincinnati, the Mott Sand Blast Mfg. Co., Chicago, and the Pangborn Corporation, Hagerstown, Md.

The displays of sand-handling and mixing machinery included principally machines of well known types. It is evident, however, that the demand for sand-handling equipment of an elaborate character is growing, and several manufacturers displayed combination machines such as core sand mixers with riddling attachments and combined sand cutting, riddling and elevating machines. Interesting displays of sand-handling and mixing apparatus were made by the Blystone Mfg. Co., Cambridge Springs, Pa., Keller Pneumatic Tool Co., Fond du Lac, Wis., Sand Mixing Machine Co., New York, and Vulcan Engineering Sales Co., Chicago.



A PORTION OF THE MACHINE TOOL EXHIBITS

mounted on a runway were shown by the Curtis Pneumatic Machinery Co., St. Louis. This concern also exhibited an interesting balanced pressure air hoist in operation.

Electric and Pneumatic Hoists

The Hayward Co., New York, showed a motor-driven clam shell bucket in operation over a sand heap. This type is particularly adapted for cleaning up large foundry floors and handling sand to and from storage bins. Air hoists and trolleys were displayed by the Vulcan Engineering Sales Co., Chicago.

Several types of electric hoists for foundry service were shown by the Shepard Electric Crane & Hoist Co., Montour Falls, N. Y., including a 3-ton cage controlled monorail hoist specially suitable for transferring castings, sand,

Welding

In the exhibits of oxy-acetylene welding apparatus standard types of generating machines, torches and auxiliary paraphernalia were displayed. Demonstrations of welding and cutting were given throughout the week. Evidence of the growing importance of electric arc welding in the foundry field was found in two displays

of arc welding machines by the General Electric Co., Schenectady, N. Y., and the Westinghouse Electric & Mfg. Co., Pittsburgh. The exhibitors of oxy-acetylene welding apparatus included the Oxweld Acetylene Co., Chicago and the Prest-O-Lite Co., Indianapolis. Thermit welding was displayed by the Goldschmidt Thermit Co., New York.

More than 225 samples of pig iron of varying analysis were displayed by Rogers, Brown & Co., Cincinnati. This comprises one of the most complete array of samples of this kind ever collected. Pickands, Brown & Co., Chicago, exhibited a model of the Panama canal made of Solvay coke and built to scale. A handsome map of the world showing Panama canal routes was distributed as a souvenir.

Air compressors and pneumatic appliances were displayed by the following: International Electric Tool Co., Milwaukee; Chicago Pneumatic Tool Co., Chicago; Cleveland Pneumatic Tool Co., Cleveland; Independent Pneumatic Tool Co., Chicago; Sullivan Machinery Co., Chicago and Curtis Pneumatic Machinery Co., St. Louis, Mo.

Foundry Specialists

Chas. C. Kawin Co., Chicago, had an attractive booth where representatives were on hand to explain the service which this concern offers to foundrymen. The Kawin company operates a large metallurgical laboratory, and in addition acts as general advisor and organizer.

Molding and core sands were exhibited by the following: F. A. Downerd, Columbus, O.; Garden City Sand Co., Chicago; Janesville Wisconsin Molding Sand Co., Janesville, Wis.; The Newport Sand Bank Co., Newport, Ky.; The Peerless Parting Co., Ottawa, Ill. and H. S. Vrooman, Chicago.

Exhibits of foundry supplies including core oils, core compounds, facings, partings, riddles, small tools, etc., were made by the S. Obermayer Co., Chicago; Buckeye Products Co., Cincinnati; Cataract Refining & Mfg. Co., Buffalo; Henion & Hubbell, Chicago; Hill-Brunner Foundry Supply Co., Cincinnati; Hill & Griffith Co., Cincinnati; J. S. McCormick, Pittsburgh; J. W. Paxson Co., Philadelphia; Robeson Process Co., Pennington, N. J.; U. S. Graphite Co., Saginaw, Mich.; Great Western Mfg. Co., Leavenworth, Kans.; Sterling Wheelbarrow Co., Milwaukee; Frederic B. Stevens, Detroit; T. B. Woods Sons Co., Chambersburg, Pa.; Wyoming Shovel Co., Wyoming, Pa.; Cleveland Wire Spring Co., Cleveland, and E. J. Woodison Co., Detroit.

The displays of metal and alloys indicated that the tendency to use prepared ingots is growing among brass foundrymen, it being possible today to obtain ingots of reliable composition. Displays of metals and alloys were made by the following: Ajax Metal Co., Philadelphia; S. Birkenstein & Sons, Chicago; Goldschmidt Thermit Co., New York; Great Western Smelting & Refining Co., Chicago; Benjamin Harris & Co., Chicago; Titanium Alloy Mfg. Co., Niagara Falls, N. Y., and Vanadium Alloys Steel Co., Chicago.

A great variety of semi-steel castings including automobile cylinders, gears, piston rings, etc., made with mixtures containing from 10 to 50 per cent steel were shown by McLain's System, Milwaukee.

The Carborundum Co., Niagara Falls, N. Y., and the Norton Co., Worcester, Mass., displayed an extensive line of refractory materials. Crucibles for foundry use were exhibited by the Jos. Dixon Crucible Co., Jersey City, N. J.

Creosoted wood blocks for foundry flooring purposes were exhibited by the Ayer & Lord Tie Co., Chicago, and the Jennison Wright Co., Toledo, O. Molders' shoes, goggles, helmets and other personal equipment for protecting workmen from injury were exhibited by the C. W. Johnson Co., Natick, Mass., Julius King Optical Co., Chicago; Wm. Horstmann Co., Philadelphia; R. P. Smith & Sons Co., Chicago; F. A. Hardy & Co., Chicago.

Data regarding electric furnaces was presented by the Metallurgic Engineering Co., Chicago.

Turning now from the foundry to the machine shop, there were a large number of displays of machine tools which amply illustrated the progress of the past year in the design and construction of metal-working machinery. In spite of the increases in the strength and power of machine tools in the past few years, it is evident that customers are not yet wholly satisfied in this direction. The demand for higher speeds and greater cutting ability is apparently as insistent as ever, but the demonstrations at the show made it plain that the machines now on the market have sufficient power to crumple any grade of tool steel without stalling.

The principal improvement of the past year in standard lathes, shapers, drill presses and milling machines include refinements in methods of motor drive, a simplification of the feed and speed change mechanism and advances in the direction of better finished tools and more handy arrangements for the convenience of the operator. The development of the turret lathe into a manufacturing machine with a wide range of possibilities was vividly illustrated by the displays on the convention floor. Also the adaptation of the gang drill to a multitude of operations ordinarily performed on a chucking lathe was illustrated. The displays of grinding machines demonstrated that the capacity of these tools at the present stage of their development is governed only by the limitation of abrasive materials.

Increased speeds have necessitated greater attention than ever to the bearings on machine tools and the ball and roller types are supplanting plain bearings in a great many cases. An Avery drill running 10,000 revolutions per minute, equipped with ball bearings furnished by the Chicago Pulley & Shafting Co., was displayed. The Cincinnati Bickford Tool Co., Cincinnati, exhibited a very interesting heavy duty, high speed radial drill which has sufficient capacity to drive a 3-inch Celfor drill 127 revolutions per minute with a feed 0.024 inch per revolution through cast iron. The cutting speed is 100 feet per minute. A drill press of the compound table type was shown by the Colburn Machine Tool Co., Franklin, Pa.

Machine Tool Exhibitors

Among the other machine tool exhibitors were the following: Acme Machine Tool Co., Cincinnati; American Tool Works, Cincinnati; Armstrong-Blum Mfg. Co., Chicago; Baker Bros., Toledo; Barber-Colman Co., Rockford, Ill.; Barnes Drill Co., Rockford, Ill.; Benjamin Electric Mfg. Co., Chicago; Chas. H. Besly & Co., Chicago; Brown & Sharpe Mfg. Co., Providence, R. I.; Cincinnati Milling Machine Co., Cincinnati; Cincinnati Planer Co., Cincinnati; James Clark Jr. Electric Co., Louisville, Ky.; G. T. Eames Co., Kalamazoo; Diamond Machine Co., Providence, R. I.; Edgemont Machine Co., Dayton, O.; E. L. Essley Machinery Co., Chicago; Gardner Machine Co., Beloit; Garvin Machine Co., New York; Gould & Eberhardt, Newark, N. J.; Gisholt Machine Co., Madison, Wis.; Graver-Klusman Tool Co., Cincinnati; Heald Machinery Co., Worcester, Mass.; International Machine Tool Co., Indianapolis; Landis Machine Co., Waynesboro, Pa.; La Salle Machine & Tool Co., La Salle, Ill.; Lodge & Shipley Machine Tool Co., Cincinnati; Marshall & Huschart Machinery Co., Chicago; Manufacturers Equipment Co., Chicago; Monarch Machine Co., Sidney, O.; National Machinery Co., Tiffin, O.; E. O. Partridge, Chicago; Reeves Pulley Co., Columbus, O.; Rockford

Drilling Machine Co., Rockford, Ill.; Rock Island Mfg. Co., Rock Island, Ill.; S. K. F. Ball Bearing Co., New York; Skinner Chuck Co., New Britain, Conn.; R. R. Street & Co., Chicago; U. S. Electric Tool Co., Cincinnati; J. D. Wallace, Chicago; Warner & Swasey Co., Cleveland, O.; Weaver Mfg. Co., Springfield, Ill.; Wilmarth & Morman Co., Grand Rapids, Mich.

Among the miscellaneous exhibits were the following: Canada Carbide Sales Co., carbide; Chicago Steel Foundry Co., steel castings, flasks and wire rope sockets; Felt & Tarrant Mfg. Co., Chicago, adding machines; Flexible Steel Lacing Co., belt lacing; David Lupton's Sons Co., Philadelphia, sash and sash operating devices; J. R. Long & Co., Akron, O., vices, pipe reamers and cutters; Mahr Mfg. Co., Minneapolis, portable torches; Metals Coating Co., Chicago, metal spraying equipment; Puro Sanitary Drinking Fountain Co., Haydenville, Mass., drinking fountains, and the Lehon Co., Chicago, roofing.

Standard Ladle Nozzles For Steel Foundries

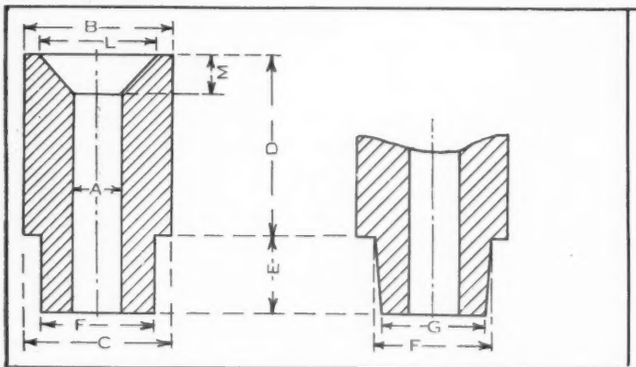
Recommendations Made by Committee on Steel Foundry Standards of American Foundrymen's Association Urging Use of Uniform Nozzles

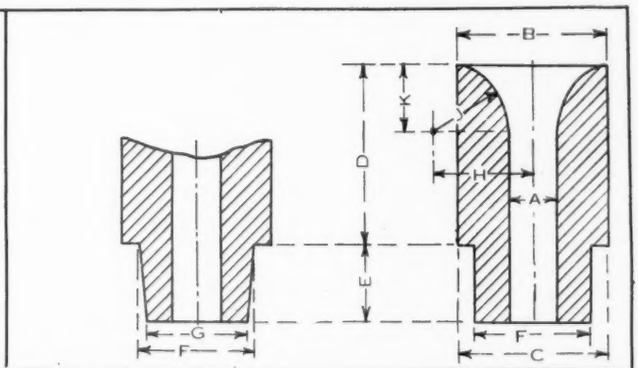
THE committee appointed to investigate the possibilities of standardization of features of steel foundry practice has been engaged during the past year in investigating methods of standardizing nozzle brick in connection with ladle equipment.

As a result of R. A. Bull's paper on some trouble encountered in pouring steel castings, which was read at the last convention of the American Foundrymen's Association, it was decided to go into the matter of standardization of nozzle brick, with the idea of cutting down the very great number of different designs that the brick people now have to supply in small quantities to the numerous foundries, and in so doing make it possible for them to improve the quality of the brick because of large scale production. The committee has made a very thorough investigation of the methods of manufacture of nozzle brick, and has found that the brick people will welcome any move in the way of standardization, as the nozzle business for the steel foundries forms only a small percentage of their total output. The troubles that various foundries have had in the past with nozzle brick, on account of the quality, are well known to all. The only remedy for these troubles seems to be the standardization of design for all of the steel foundries of this country, so that the larger user and the small alike can be assured of a uniform product properly selected with regard to its constituent materials, properly tempered before being put in the kiln and properly treated in the kiln.

The committee has found that there

Report of committee on steel foundry standards submitted by the chairman, Dudley Shoemaker, of the American Steel Foundries, Indiana Harbor, Ind., at the Chicago convention, Sept. 7-11.





Name of Foundry.	Dimensions in Inches A	B	C	D	E	F	G	L	M
Wellman-Seaver-Mor..	2	5½	5	5	1	4	4	4½	7/8
Union Steel	2½	5¼	4 1/8	4½	1½	3 7/8	3 5/8	4½	1 1/8
National Malleable...	2 1/8	6	5 1/8	5 7/8	1 3/8	4 1/8	3¾	5¼	1 7/8
National Malleable...	...	5 1/8	4 7/8	3 7/8	1½	3	2½	5 1/8	1 1/8
National Malleable...	...	5¼	5	4½	1½	3¾	3¼	5¼	1½
American Bridge.....	3	5½	5 1/8	5¾	1½	4	4	4½	1
American Bridge.....	2	5½	5 1/8	6¼	1½	4	3	4½	1 1/2
Columbia Steel.....	2	5¾	5 1/8	5	1¾	4 3/8	4 1/8	4½	½
Hubbard Steel.....	2½	6	5 5/8	6 5/8	3	4½	4¼	4¾	¾
Seaboard Steel.....	2 1/8	5¼	5 1/8	4 5/8	2	3¼	3 1/8	3¼	¾
Wheeling Mold.....	3	5 7/8	5 7/8	7	2¼	4½	4½	5 1/8	1¾
Baldt Steel.....	...	6	6	4	2	5	5	4	¾
Baldt Steel.....	...	6	6	4 5/8	2	4¾	4½	3 3/8	½
Allegheny Steel.....	2	6	6	7	4	4½	4½	4¾	1½
Detroit Steel.....	1¾	5¾	5¾	6¼	2	3½	3½	4¼	1 1/8
National Foundry....	2	5½	5½	4½	3	3½	3½	4½	1
Ohio Steel	1½	5¾	5¾	7	1 1/8	4½	4½	4 1/8	...
Ohio Steel	3	5¾	5¾	7	1 1/8	4½	4½	5	...
Penn Steel Castings.	2	4 1/8	4 1/8	3 3/8	2 3/8	3¾	3¾	2¾	3/8
Penn Steel Castings.	2½	6¼	6¼	4 3/8	2	4¾	4 5/8	3½	2 3/8
Penn Steel.....	2½	7	7	4	1¾	4¾	4¾	6	1/8
St. Louis Steel.....	1½	5¼	5¼	4¼	1½	4 1/8	2 7/8	4¼	1¼
Strong Steel	1½	5¼	5¼	4½	2 1/8	3½	3	4¼	1 1/8
American Steel Fdys.	2	5 1/8	4 1/8	7	1¾	3 3/8	3 3/8	4¾	1 1/8
Bettendorf Co.	1¾	5 3/8	5 3/8	6¾	2½	3¼	3¼	4¾	1 1/8
Average	2¼	5 5/16	5 1/16	5 1/16	2	4	3 13/16	4 7/16	1 5/32

Name of Foundry.	Dimensions in Inches A	B	C	D	E	F	G	H	J	K
Birdsboro Steel..	2½	5 7/8	5 3/8	4¾	2¼	4½	4¼	2½	1¼	1¼
Birdsboro Steel..	3	5 7/8	5 3/8	4¾	2¼	4½	4¼	2¾	1¼	1¼
Bucyrus Co.	2	7	6½	4	1 7/8	4 7/8	4	3	2	2
Cleveland Steel..	2	6½	5 5/8	5 1/8	2	4 3/8	4 1/8	3½	2 7/8	2 3/8
Chester Steel....	2	5 7/16	4 7/8	4 7/8	1 7/8	4	3¼	2½	1½	1½
General Electric.	2	5½	4 7/8	4	1½	3¼	3 3/8	3 7/16	2 7/16	2 3/8
General Electric.	2	5½	5	4	1½	3 5/8	3 3/8	3¼	2¼	2 1/8
Monarch Steel...	1½	5¼	4 7/8	5	1½	3½	3½	3	2¼	2 1/8
A. J. Haw & Sons.	2	4¾	4½	4	1¼	3¼	2¾	1 7/8	1½	1 1/8
Duquesne Steel..	1½	5	5	4	2½	3 5/8	3 5/8	3 1/8	3¾	3½
Jones & Laughlin.	1½	5 5/8	5 5/8	8½	1¼	4 1/8	4 1/8	2¾	2	2 1/8
Jones & Laughlin.	2¼	5 5/8	5 5/8	8½	1¼	4 1/8	4 1/8	2¼	2	2½
Lawrence Steel..	1¾	4¾	4¾	4	1¼	3¼	3	3 3/8	2½	2½
McConw'y&Torl'y.	2	4 9/16	4 9/16	7	1½	3 1/16	2 11/16	3 1/16	2	1 7/8
Mesta Machine..	2½	5½	5½	5¼	1¾	4 1/16	4 1/8	2	¾	¾
Mesta Machine..	3½	6¼	6¼	5½	1¾	4 7/8	4½	2½	¾	¾
Ft. Pitt Foundry	3	5½	5½	5	1 1/16	4½	4¼	2½	1	1 1/16
Com'wealth Steel	2½	5 5/8	5 5/8	6½	1½	3½	3¼	2 5/8	1	1¼
Scullin-Gallagher.	2	6	6	5½	1 5/8	3¾	3	3 1/8	2¼	2¼
National Steel...	2	4¾	4¾	4 1/8	1½	3 1/16	2½	3½	2½	2¼
Buckeye Steel...	1½	6 5/16	6 5/16	5¾	1 5/8	3 7/8	3 1/16	3 5/16	2 7/8	2 7/8
Falk Co.....	2½	5½	5½	3¾	1 7/16	4	4	...	...	...
Falk Co.....	2	4½	4½	3¾	1 7/16	3 1/16	3	...	...	...
Amer. St'l Fdys.	2	6¼	6 1/8	4 5/8	2	4 5/8	4½	3½	2½	2¼
Pittsburgh Steel.	3	5 3/8	5 3/8	4½	1 1/16	3¾	3 5/8	3	1½	1 1/8
Prime Steel.....	1¼	6	6	4	1 5/8	3¾	3	3	1 7/8	1¾
Otis Steel.....	2½	6	5	4¾	2	4½	4½	...	...	...
Average.	2 3/16	5 1/16	5 1/16	5	1¾	3 31/32	3 31/32	2 31/32	1 11/16	1 31/32

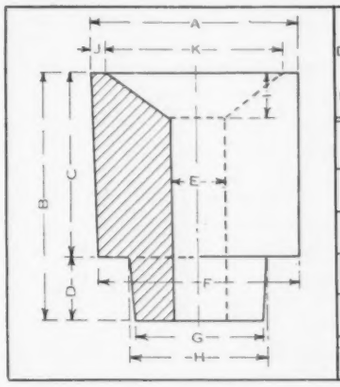
FIG. 1—DIMENSIONS OF NOZZLES IN USE IN VARIOUS STEEL FOUNDRIES

is absolutely no reason why a uniform product cannot be obtained with nozzles than with the best grades of clay brick. The trouble has not been that of the unwillingness of the brick makers to supply satisfactory material, but rather on account of the fact that quick delivery demands have been made on small quantities and repeated changes in design have had to be met by the brick makers, with the result that the manufacturers becoming discouraged over the possibility of working up a profitable business among the steel foundries, treated the matter rather as a side issue, depended on their standard designs of brick for their profit, and took care of the requirements of the steel foundries with regard to nozzles in order to keep in their good graces.

That the standardization of this feature of steel foundry practice will be of great benefit to all of the steel foundries, as well as to the brick makers, cannot be denied, therefore the committee on this subject respectfully suggests that the standard nozzle design that is submitted herewith as being satisfactory for all steel foundry practice be given at least a fair trial by all.

The committee realizes that it is an utter impossibility to please everybody in a matter of this kind. Certain results in certain foundries are supposed to come from certain peculiar shapes, sizes and angles and radii in connection with the nozzle. It is the opinion of the committee that in a great many cases this is merely a matter of sentiment on the part of shop men, and that once a standard design has been given a fair trial, satisfactory results will be obtained, and it will be decided to continue the use of this design of nozzle.

the nozzle decided on by the committee does not represent the exact average of all of the dimensions received, there have been few radical departures from the average, the aim being to decide on a design that would



DIAMETER OF NOZZLE	A	B	C	D	E	F	G	H	I	J	K
INCHES	INCHES										
1½	6¼	6¾	5	1¾	1½	6¼	3⅝	3¾	1¼	⅜	5
1¾	6¼	6¾	5	1¾	1¾	6¼	3⅝	3¾	1 1/16	⅜	5
2	6¼	6¾	5	1¾	2	6¼	4½	4⅝	1¼	⅜	5
2½	6¼	6¾	5	1¾	2½	6¼	4½	4⅝	1 1/16	⅜	5
3	6¼	6¾	5	1¾	3	6¼	4½	4⅝	1 5/16	⅜	5

FIG. 3—RECOMMENDED DIMENSIONS FOR STRAIGHT FACE NOZZLES

be adopted most easily by all. There appears to be an equal division of opinion in regard to the relative desirability of the round face and straight face nozzle. This being the case, the committee recommends that two general designs of nozzle, shown in Figs. 2 and 3, be decided on as standard, one having the round face and the other the straight face.

The committee recommends that five sizes of nozzles be decided on for each of the general designs, the sizes to be as follows: 1½, 1¾, 2, 2½ and 3-inch diameter hole.

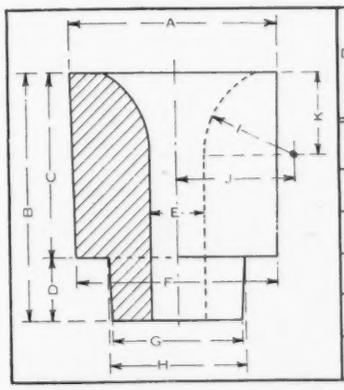
The outside diameter of the smaller size nozzles might appear to some to be a little large, but it was decided that it would be best to keep this dimension constant for all sizes of nozzles, and this decision was reached because we believe that it would be

to stand up under a severe temperature, as well as under hard mechanical usage, the wisdom of this decision can be realized.

It has been recommended that certain specifications should be drawn up relative to the degree of hardness constituency of the clay to the temperature that the standard nozzle must withstand in order to meet requirements of steel foundries. The committee, upon investigation, finds that it is impossible to tell what degree of hardness has been obtained in baking, other than by testing with a blunt instrument. The constituency of the clay cannot be determined by analysis, and each manufacturer must decide for himself what kind of clay will be satisfactory for his purpose.

It is the opinion of the committee that brick makers distinctly should understand that this standardization is of particular interest to the steel foundrymen only. They should be made to realize that because a particular product gives satisfaction in rolling mill ingot practice, that fact is no criterion of its usefulness in the steel foundry, where the most severe service is encountered.

Blue prints of the standard designs of straight and round face nozzles will be forwarded to all brick makers who make nozzles, with the statement that they represent the standard nozzle as decided upon by the American Foundrymen's Association committee, and with the request that they prepare molds in anticipation of orders for nozzles of these designs. It is obvious that the success of this scheme depends upon the co-operation of all of the members of the association, and it is hoped by the committee that its efforts will be appreciated by the other members of the association to the extent of giving the standard nozzle a thorough try-out, with the idea of adopting it should no troubles be encountered with respect to the suggested design.



DIAMETER OF NOZZLE	A	B	C	D	E	F	G	H	I	J	K
INCHES	INCHES										
1½	6¼	6¾	5	1¾	1½	6¼	3⅝	3¾	2½	3¼	2¼
1¾	6¼	6¾	5	1¾	1¾	6¼	3⅝	3¾	2⅜	3¼	2⅛
2	6¼	6¾	5	1¾	2	6¼	4½	4⅝	2½	3½	2¼
2½	6¼	6¾	5	1¾	2½	6¼	4½	4⅝	2¼	3½	2
3	6¼	6¾	5	1¾	3	6¼	4½	4⅝	2	3½	1¾

FIG. 2—RECOMMENDED DIMENSIONS FOR ROUND FACE NOZZLES

In compiling the standard your committee got in touch with 42 of the principal steel foundries of this country. The answers are shown in Fig. 1. All of the big manufacturers of steel castings are represented, and while good policy to make the dimension of the brick generous, on account of the importance of its work. When it is realized that the successful casting of 20 tons of metal or over depends upon the ability of a small clay brick

A Cast Iron of Unusually Interesting Structure

A Discussion of the Peculiar Characteristics of a Cast Iron With a Strength of 42,000 Pounds Per Square Inch

By K W Zimmerschied

FROM time to time a number of able articles on the structure and properties of cast iron have appeared treating, collectively, of all the grades and varieties of metal. In the examination of many samples of iron entering into the structure of important automobile parts, the writer has had a good opportunity to test the theories presented in these articles, by applying them to the structures encountered. In the main, these theories are well borne out by the facts in practice; often we encounter cases, however, wherein the hypotheses advanced do not suffice to explain the situation entirely. There seem to be additional factors entering into the problem which need elucidation, and we hope to be able to go into these at some future time. The purpose of this article is to present a rather unusal case, in substantiation of published theories, in as untechnical a manner as the subject allows, first sketching as briefly as possible the substance of these theories.

Paper read at the annual meeting of the American Foundrymen's Association Chicago, Sept. 8-11.

Ever since Professor Henry M. Howe's presentation of his conceptions, cast iron through its whole range from malleable to white iron has been considered in the light of an extension of the steel series, in which the graphite, when present, plays the role of a large admixture of foreign matter. This steel matrix may, exclusive of the graphite present, be itself either low or high in combined carbon, and may vary within wide limits as to the amount of other elements present. The properties of any good sample of iron will therefore depend upon (1) the properties of the steel matrix, and (2) the physical influences of the substances embedded therein.

In the case of blackheart malleable iron, where all the carbon in the interior of the casting is in the combined form after the annealing processes, the properties of the finished part are very similar to those of a very low carbon steel, as is well known. There are other products which have similar characteristics, one of which is shown in Fig. 1.

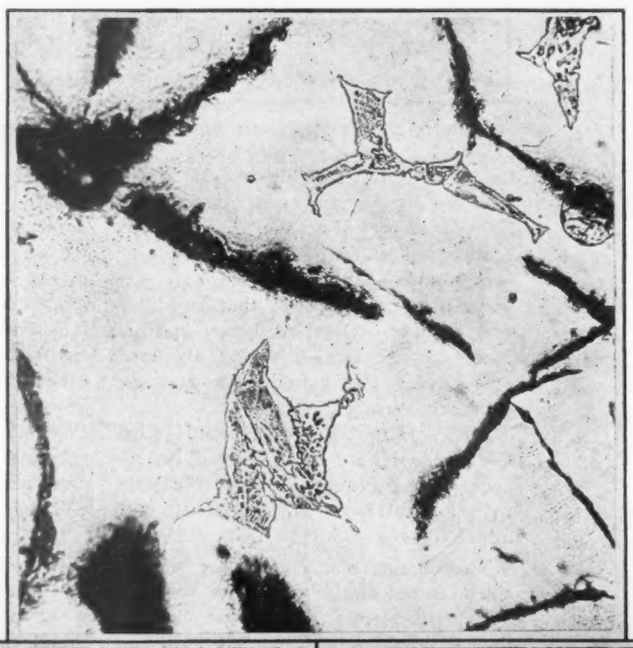


FIG. 1—IRON WITH GRAPHITE PRESENT IN LARGE PLATES
Magnified 500 Times and Etched with Picric Acid

FIG. 2—IRON CONTAINING SOME COMBINED CARBON
Magnified 100 Times and Etched with Picric Acid

FIG. 3—STRUCTURE OF DARK MATERIAL SHOWN IN FIG. 2
Magnified 500 Times and Etched with Picric Acid

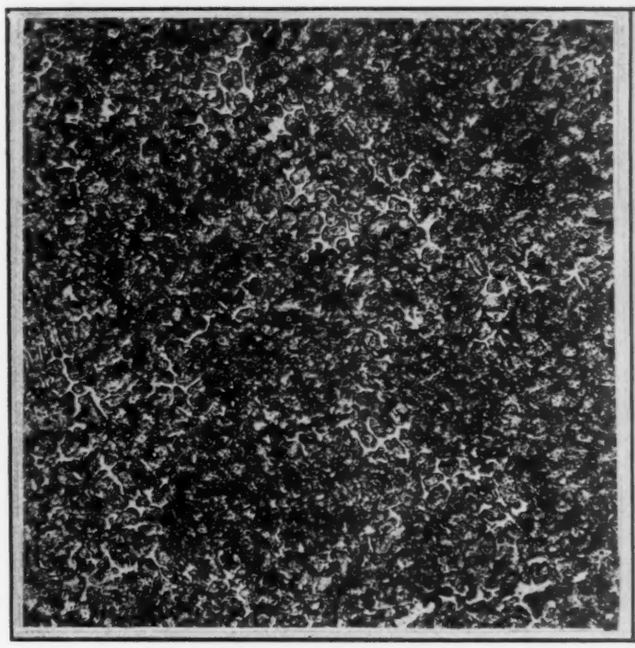


FIG. 4—IRON WITH CARBIDE STRUCTURE
Magnified 100 Times and Etched with Picric Acid

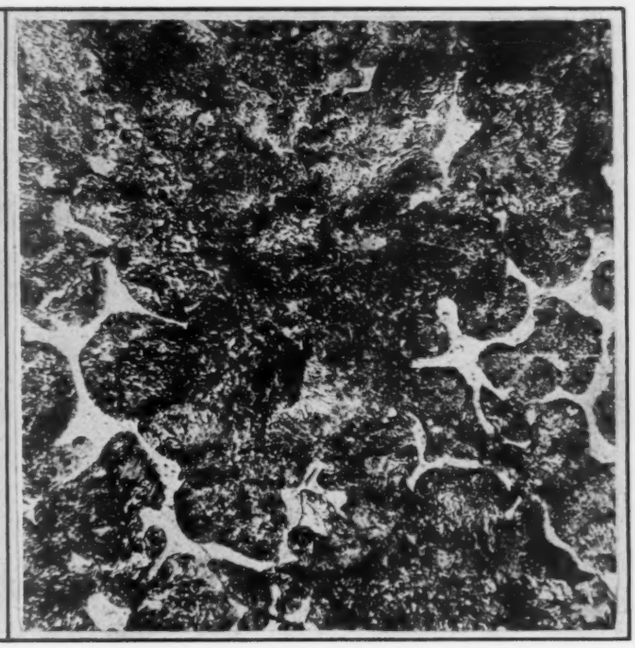


FIG. 5—STRUCTURE OF THE WHITE, HIGH CARBON PORTIONS OF IRON SHOWN IN FIG. 4
Magnified 500 Times and Etched with Picric Acid

This iron is free from combined carbon, and has been so slowly cooled that the graphite is present in large plates. It is therefore very much like an annealed malleable casting in the large amount of free iron present but is very different in the condition of the uncombined carbon and this difference is manifested by the much greater brittleness caused by the large graphite plates. It happens that the sample pictured in this photograph contains enough phosphorus to give rise to phosphide-carbide eutectic, which is very clearly shown in the center and between two large plates of graphite, embedded in ferrite or pure iron. This constituent adds to the brittleness of this sample.

In Figs. 2 and 3 is illustrated an iron containing some combined carbon. Fig. 2 is a sample etched with picric acid and photographed at a magnification of 100 diameters. In it we find a very considerable amount of graphite, which is present in black curved plates; between these plates we find a large amount of dark material, and surrounding them a considerable amount of a white constituent, which is pure iron or ferrite. The structure of the dark material is better seen in Fig. 3, taken at 500 diameters. It is very likely that the primary graphite plates in this sample were formed by the decomposition of carbide, while the iron was still in a mushy condition, that is, viscous enough to allow the crystals of this element to take their natural form. As the metal cooled, there was additional decomposition of the surround-

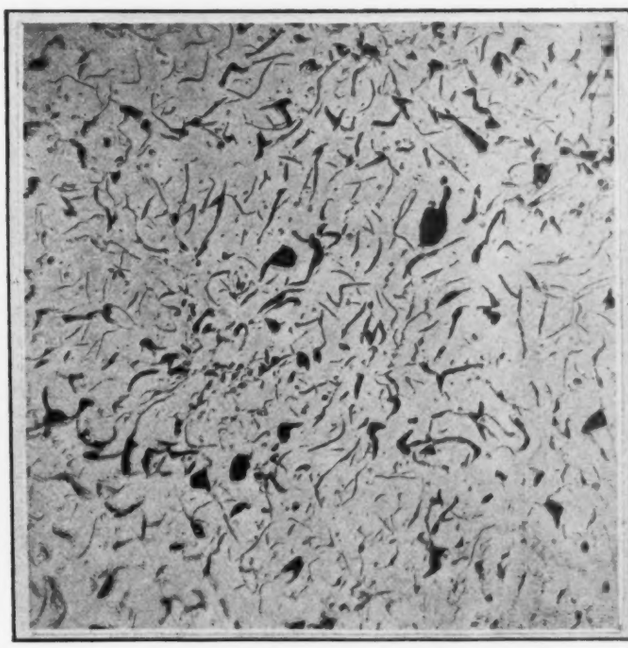


FIG. 6—CENTER OF A 1-INCH BAR
Magnified 100 Times and Polished

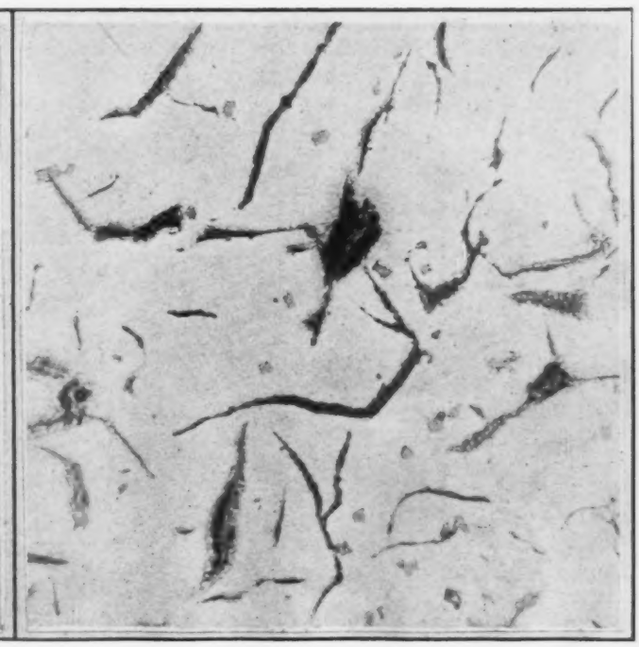


FIG. 7—SAME SECTION AS SHOWN IN FIG. 6 WITH INCREASED MAGNIFICATION
Magnified 500 Times and Polished

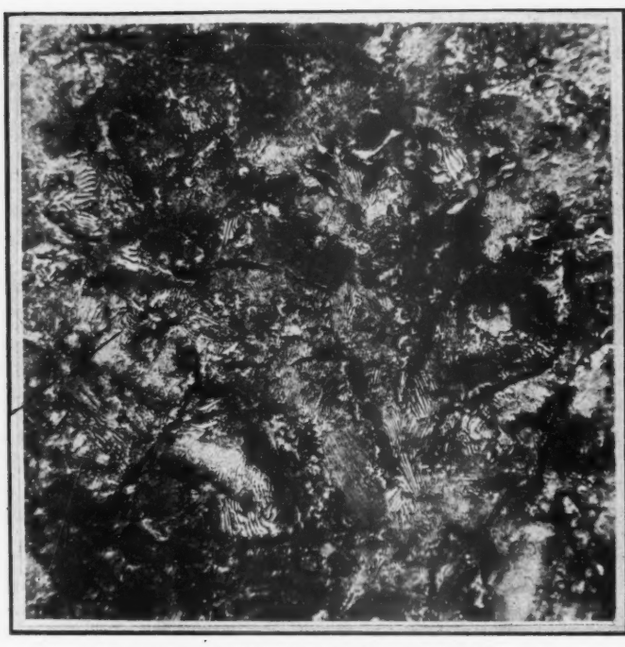


FIG. 8—STRUCTURE OF BAR SHOWN IN FIGS. 6 AND 7
Magnified 500 Times and Etched with Picric Acid

FIG. 9—STRUCTURE NEAR EDGE OF BAR SHOWN IN FIG. 6
Magnified 100 Times and Polished

ing metal, which resulted in the formation of pure iron of the one hand and of deposited graphite on the surface of the original plates on the other. It seems that the presence of a small amount of graphite acts as an energizer in the decomposition of additional carbide, which explains the circumstance that the crystals of free iron are very seldom isolated in the middle of the dark areas, but are most often found surrounding the primary graphite crystals. The dark areas consist of eutectic, which is known to metallographists and probably to the most of those who have paid any attention to this study, as pearlite, that is, a constituent which contains about 0.90 per cent of combined carbon and which occurs in slowly cooled steel. It is composed of alternate plates of carbide of iron and, since the carbide is a hard and brittle substance, its effect upon this structure is to reinforce the ferrite associated with it and to strengthen it, very much as steel bars reinforce and strengthen a mass of concrete. It goes without saying, therefore, that, the higher the pearlite content of an iron or steel, all other things being equal, the higher the tensile strength and the lower the ductility of the metal as a whole. Concerning the causes which underlie in occurrence of these constituents, and the relative amounts of them, it is well known that the balance between silicon on the one hand and sulphur and manganese on the other, taken together with the rate of cooling, exert the greatest influence. As the percentage of silicon rises or as the rate of cooling increases, the amount of free carbon increases and the amount of ferrite or pure iron also increases; conversely, as the amount of sulphur or manganese increases or as the rate of cooling

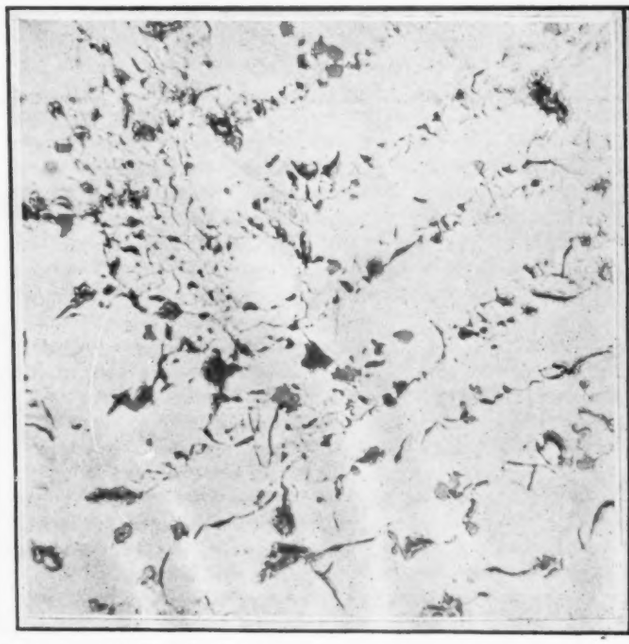


FIG. 10—STRUCTURE NEAR EDGE OF BAR SHOWN IN FIG. 6
Magnified 500 Times and Polished

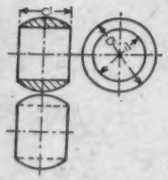
FIG. 11—INTERNAL STRUCTURE OF BAR NEAR EDGE
Magnified 500 Times and Etched with Picric Acid

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

FORMULAE FOR FINDING THE WEIGHTS OF CASTINGS

By W. L. Tryon



To find the weight of a ring made by cutting a cylindrical hole through the center of a sphere, multiply the chord cubed by the value of k corresponding to the weight per cubic inch of material used. (See table below).

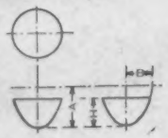
$$W=C^3k$$

The chord is equal to the square root of the result obtained by subtracting the square of the diameter of the hole from the square of the diameter of the sphere.

$$C=\sqrt{D^2-d^2}$$

To find the weight of a ring of triangular cross-section, multiply the base of the triangle by its altitude by the sum of twice the diameter of the circle described by the center of the base and the diameter described by the vertex of the triangle by the value of k.

$$W=BT(2D+d)k$$



To find the weight of a segment of an ellipsoid, when the base is parallel to the revolving axis, multiply the difference between three times the fixed semi-axis and the height of the segment by the square of the height, by the square of the revolving semi-axis by the value of m and divide by the square of the fixed semi-axis.

$$W=\frac{(3A-H)H^2B^2m}{A^2}$$

ALL DIMENSIONS IN INCHES AND WEIGHTS IN POUNDS

Wt. per cu. in.	k	m	Wt. per cu. in.	k	m	Wt. per cu. in.	k	m	Wt. per cu. in.	k	m
.096	.0503	.1005	.210	.1100	.2199	.330	.1728	.3456	.450	.2356	.4713
.100	.0524	.1047	.220	.1152	.2304	.340	.1780	.3561	.460	.2408	.4817
.110	.0576	.1152	.230	.1204	.2408	.350	.1832	.3666	.470	.2460	.4922
.120	.0628	.1257	.240	.1257	.2513	.360	.1885	.3770	.480	.2513	.5026
.130	.0680	.1361	.250	.1309	.2618	.370	.1937	.3875	.490	.2565	.5131
.140	.0732	.1466	.260	.1361	.2722	.380	.1989	.3980	.500	.2617	.5236
.150	.0785	.1571	.270	.1414	.2827	.390	.2042	.4084	.510	.2670	.5341
.160	.0838	.1675	.280	.1466	.2932	.400	.2094	.4189	.520	.2722	.5446
.170	.0881	.1780	.290	.1518	.3037	.410	.2146	.4294	.530	.2774	.5550
.180	.0943	.1885	.300	.1571	.3142	.420	.2199	.4399	.540	.2827	.5654
.190	.0995	.1990	.310	.1623	.3247	.430	.2251	.4504	.550	.2879	.5759
.200	.1047	.2094	.320	.1675	.3352	.440	.2303	.4609	.560	.2931	.5864

INTERPOLATION TABLE

Add'l. Wt.	Add'l. k	Add'l. m	Add'l. Wt.	Add'l. k	Add'l. m	Add'l. Wt.	Add'l. k	Add'l. m
.001	.0005	.0010	.004	.0021	.0042	.007	.0037	.0073
.002	.0010	.0021	.005	.0026	.0052	.008	.0042	.0084
.003	.0016	.0031	.006	.0031	.0063	.009	.0049	.0094

For method of interpolation see Data Sheet No. 129.

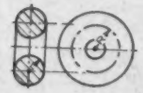
DATA SHEET NO. 171, THE FOUNDRY, Oct., 1914.

FORMULAE FOR FINDING THE WEIGHTS OF CASTINGS

By W. L. Tryon

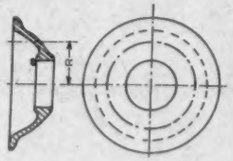
To find the weight of a ring of elliptical cross-section, multiply the radius of the circle passing through the center of the cross-section by the large diameter of the ellipse by the small diameter by the value of the constant, K, corresponding to the weight per cubic inch of material used.

$$W=RDdK$$



To find the weight of a ring of circular cross-section, multiply the radius of the cross-section squared by the radius of the circle passing through the center of the cross-section by the value of M.

$$W=r^2RM$$



To find the weight of a solid generated by revolving a plane area about an axis, multiply the area by the distance from the center of gravity of cross-section to the axis by the value of N.

$$W=ARN$$

ALL DIMENSIONS IN INCHES AND WEIGHTS IN POUNDS

Wt. per cu. in.	K	M	N	Wt. per cu. in.	K	M	N	Wt. per cu. in.	K	M	N
.096	.474	1.895	.603	.250	1.234	4.935	1.571	.410	2.023	8.093	2.576
.100	.494	1.974	.628	.260	1.283	5.132	1.634	.420	2.073	8.291	2.639
.110	.543	2.171	.691	.270	1.332	5.330	1.696	.430	2.122	8.488	2.702
.120	.592	2.369	.754	.280	1.382	5.527	1.759	.440	2.171	8.685	2.765
.130	.642	2.566	.817	.290	1.431	5.724	1.822	.450	2.221	8.883	2.827
.140	.691	2.764	.880	.300	1.481	5.922	1.885	.460	2.270	9.080	2.890
.150	.740	2.961	.942	.310	1.530	6.119	1.948	.470	2.319	9.277	2.953
.160	.790	3.158	1.005	.320	1.579	6.317	2.011	.480	2.369	9.475	3.016
.170	.839	3.356	1.068	.330	1.629	6.514	2.073	.490	2.418	9.672	3.079
.180	.888	3.553	1.131	.340	1.678	6.711	2.136	.500	2.468	9.870	3.142
.190	.938	3.751	1.194	.350	1.727	6.909	2.199	.510	2.517	10.067	3.204
.200	.987	3.948	1.257	.360	1.777	7.106	2.262	.520	2.566	10.264	3.267
.210	1.036	4.145	1.319	.370	1.826	7.304	2.325	.530	2.616	10.462	3.330
.220	1.086	4.343	1.382	.380	1.875	7.501	2.388	.540	2.665	10.659	3.393
.230	1.135	4.540	1.445	.390	1.925	7.698	2.450	.550	2.714	10.857	3.456
.240	1.184	4.737	1.508	.400	1.974	7.896	2.513	.560	2.764	11.054	3.519

INTERPOLATION TABLE

Add'l. Wt.	Add'l. K	Add'l. M	Add'l. N	Add'l. Wt.	Add'l. K	Add'l. M	Add'l. N	Add'l. Wt.	Add'l. K	Add'l. M	Add'l. N
.001	.005	.020	.007	.004	.020	.079	.025	.007	.035	.138	.044
.002	.010	.039	.013	.005	.025	.099	.031	.008	.039	.158	.050
.003	.015	.059	.019	.006	.030	.118	.038	.009	.044	.178	.057

For method of interpolation see Data Sheet No. 129.

For finding Center of Gravity, see Data Sheet No. 112.

For finding Area of Irregular Figures, see Data Sheet No. 111.

DATA SHEET NO. 172, THE FOUNDRY, Oct. 1914.

decreases, the amount of combined carbon increases and the percentage of ferrite decreases.

The first effect of increase in the combined carbon is to cause an increase in the amount of pearlite with a corresponding increase in the strength of the iron. When this has progressed to such a point as to give us a structure made up entirely of pearlite and graphite we obtain an iron which is the strongest possible in tensile strength, although it is not necessarily the most resistant to shocks on account of its greater brittleness. When the amount of silicon is sufficiently reduced however, we come into the next stage where the amount of combined carbon rises to such an extent that it exists as carbide in excess of the carbide contained in the structural entity which we have described as pearlite. An example of this condition is given in Figs. 4 and 5, which illustrate an iron containing 2.15 per cent silicon. In Fig. 4, taken at 100 diameters from the etched specimen, we find again a considerable amount of white material. In this case, however, it has a very different form from that seen in Figs. 2, and 3 and is very easily distinguished from ferrite in the original sample, owing to the fact that it stands up from the surface in decided relief, after polishing. This constituent contains free carbide in excess of the carbon occuring in pearlite and is so hard and brittle that it has an even greater influence upon the brittleness of the iron in which it is embedded, than has the graphite with which it is also associated. An examination of Fig. 5, taken at a magnification of 500 diameters, shows how this white, high carbon constituent occurs embedded in the pearlite and also shows the very finely divided condition in which the graphite occurs, the latter being scarcely distinguishable in its background of pearlite. It happens that the sample pictured here was cast in a thin section and that it is also quite high in phosphorus. These two circumstances have the effect of causing the graphite to be deposited rather late, after the iron has become too stiff to allow the carbon to take its natural form, with the result that it occurs most frequently in such cases, in very small particles.

Limits are Narrow

From the above examples and discussion it will be seen that the limiting conditions for obtaining an iron of ideal structure cover only a very narrow range. We have met with a number of irons in automobile castings which approximated this structure, but have only one good sample which can be said to consist entirely of pearlite and graphite, with the possible admixture of manganese sulphide. Analysis shows this iron is higher in silicon than the iron in Fig. 1 and will therefore, all other things being equal, be expected to run higher in uncombined carbon; the amount of sulphur, however, is also much higher and this element has such a strong influence in holding the carbon in the combined form that the effect of the silicon is overcome to the end that the steel matrix is practically "eutectoid."

Fig. 6 illustrates the center of a one-inch bar, the photograph being taken at a magnification of 100 diameters, from the polished, but unetched surface of the iron. Fig. 7 is taken at a magnification of 500 diameters, under the same conditions. These two pictures show the medium sized curved plates of graphite and between these we find the globular patches of manganese sulphide in Fig. 7, these being so pronounced on account of the high sulphur content of the iron.

Key to Figures and Compositions

Figure.	Magnifications.	Etching Medium.	Chemical Composition. C. C., per cent.	G. C., per cent.	T. C., per cent.	Mn., per cent.	P., per cent.	S., per cent.	Si., per cent.
1	500	Picric	Trace	3.52	3.52	0.42	0.409	0.027	2.53
2	100	Picric	0.25	2.48	2.73	0.52	0.316	0.114	3.12
3	500	Picric	0.25	2.48	2.73	0.52	0.316	0.114	3.12
4	100	Picric	0.79	2.48	3.27	0.26	1.221	0.090	2.15
5	500	Picric	0.79	2.48	3.27	0.26	1.221	0.090	2.15
6	100	Polished	0.64	2.30	2.94	0.47	0.137	0.136	3.12
7	500	Polished	0.64	2.30	2.94	0.47	0.137	0.136	3.12
8	500	Picric	0.64	2.30	2.94	0.47	0.137	0.136	3.12
9	100	Polished	0.64	2.30	2.94	0.47	0.137	0.136	3.12
10	500	Polished	0.64	2.30	2.94	0.47	0.137	0.136	3.12
11	500	Picric	0.64	2.30	2.94	0.47	0.137	0.136	3.12

In Fig. 8, taken of the etched surface, at a magnification of 500 diameters, we find that the internal structure is made up of the same graphite plates which are prominent in the unetched sample, surrounded entirely by sharply defined lamellar pearlite, without any evidences of ferrite on the one hand or of cementite or free carbide on the other.

Figs. 9 and 10 show the structure of the unetched iron, at 100 and 500 magnifications again, at a point near the edge. The quicker cooling on the outside has given rise to a characteristic pseudo-crystalline structure, which structure forms a very interesting study by itself. Suffice it to say that at this time, however, we again have graphite in finer plates than occurred in the center of the casting, although the internal structure as given in Fig. 11 is practically the same. In the center of this photograph is a rather large dark area, in which the lines of pearlite are much less distinct than in the lighter portions. A close examination under the microscope however, reveals the fact that the substance is practically a mass of very fine pearlite, in which is embedded a considerable amount of rounded graphite. The presence of a very few small areas of free carbide in this photograph can also be attributed to the quicker cooling near the edge which has allowed insufficient time for the establishment of perfect equilibrium.

Combined Carbon Low

It will be noted that the combined carbon in this sample is reported as being 0.64 per cent, which is considerably below that generally ascribed as pure pearlite. This circumstance is explained in part by the unavoidable errors which creep into the methods of analyzing a cast iron for combined carbon; since our only methods for determining this constituent are either by analyzing for total carbon, then subtracting from this the result of an analysis for graphitic carbon; or else by determining it directly by the color method. It will be seen that one procedure is at least open to the combined errors of two indirect determinations, only one of which can be said to approach the exactness of our other chemical methods; the other depends upon the accuracy of a colormetric determination of doubtful reliability. In the second place we must deduct from the total weight of iron, the amount of other impurities present, in order to arrive at the amount of combined carbon which would count for total pearlite in the steel matrix and, third, it has not been established beyond a doubt that total pearlite always consists of exactly 0.90 per cent carbon.

In support of the contention that the increase of pearlite accompanies an increase in strength, we would note that the tensile strength of this iron averaged 42,000 pounds per square inch. Most of our irons, which approximate the structure shown in Figs.

2 and 3, run between 32,000 and 36,000 pounds per square inch.

Concerning the question of shrinkage, which will probably occur to the practical foundryman, we might state that this iron is admirable in its freedom from the shrinkage which is liable to occur with many other structures, notably those higher in combined carbon. The graphite is liberated at a time during the solidification when the freezing shrinkage is large, thus counteracting the tendency to sponginess; later on in the cooling, the transformation of combined carbon, which is present in the form of dissolved carbide into the plates of free carbide which form, with ferrite, the matrix of pearlite, causes again a slight expansion which decreases the amount of total shrinkage occurring in the casting.

Malleable Furnace Difficulties

By Harrold Hemenway

Question:—Recently we installed a cycloidal blower, operating at 1,350 revolutions per minute, with a capacity of 6,850 cubic feet of free air at 4½ ounces pressure. Formerly our air furnace was equipped with a blower operating at 1,800 revolutions per minute and which had a capacity of 10,000 cubic feet of free air at a pressure of 8 ounces. The blast pipe was 12 inches in diameter. The charges contained 1.23 to 1.10 per cent silicon and when operating the old blower we never experienced any trouble. However, with the cycloidal fan, we have been compelled to reduce the silicon from 0.75 to 0.85 per cent, yet in spite of this fact we experience difficulties in annealing our castings properly. The new fan which we installed is a volume blower, the blast pipe being 15 inches in diameter. What we would like to know is whether a volume blower furnishes sufficient air in a forced draft furnace to insure good malleable iron. We cannot remove sufficient silicon in the air furnace, as at present equipped, to make good castings. We have been melting our metal, consisting of 10 to 11 tons per heat, in 3 hours and 15 minutes.

Answer:—A volume blower will furnish sufficient air to insure making good malleable iron. To remove more silicon in the air furnace it will be necessary for you to increase the volume of air over the top of the metal, admitted through the bung blast pipes. Not having a sketch showing the piping, it is difficult to advise how these changes could be made to overcome your present trouble.

The easiest method would be to increase the diameter of the bung blast pipes. If you are using four or five bung blast pipes, the most satisfactory method would be to increase the number of openings to either six, eight or ten, according to the width of the furnace, the bung blast pipes to be 1¾ to 2 inches in diameter.

By having the smaller sized openings the air entering the furnace will have sufficent force to produce a cutting flame and the increased number will give more volume. With 10 openings, the air entering the furnace will spread so as to strike the iron in a sheet instead of in grooves, as with four or five openings.

If you are using only five or six bung blast openings, a second row of openings can be arranged, which will give good results. Owing to the reduced pressure it might be necessary to increase the diameter of the top blast connection. The effect of these changes should be carefully watched, varying the mixture slightly when they are made. Changes should not be made too rapidly, as their effect will not be noticeable at once.

If you have reduced the silicon in the charges to 0.75 to 0.85 per cent, with some slight reduction in the furnace, the castings should anneal properly, if the carbon has been reduced. With the bung blast pipes properly arranged, air furnaces can be operated successfully with a volume blower giving only 1½ ounces of pressure at the bung openings.

To Prevent Iron Chilling

By W. J. Keep

Question:—We recently have experienced some difficulty with our gray iron mixture. Our average analysis follows: Silicon, 3.10 to 3.25 per cent, average about 3.15 per cent; sulphur, 0.109 to 0.124 per cent; manganese, 0.67 to 0.71 per cent. The resulting iron is rather close-grained and in some cases small cast iron plugs have a slight chill on the outside where the thread is to be cut.

Answer:—You evidently increased the silicon to overcome this chill, which would be the correct procedure if you kept your sulphur below 0.08 per cent, or even 0.10 per cent. It is doubtful whether you will be able to prevent chill with the sulphur so high. If the total carbon were a little higher, the iron would not absorb so much sulphur. We would suggest that you change your fuel and obtain one containing a lower percentage of sulphur. Try a small amount of powdered ferro-manganese in each ladle before the iron is caught in it. In addition, your attention should be directed to the fact that hot melting reduces sulphur.

Remodeling an Old Cupola

By W. J. Keep

Question.—We have an old style, oval cupola which is lined to 32 x 42 inches and is equipped with six tuyeres, 4 x 10 inches. These tuyeres are 10 inches from the bottom plate and at a point 10 inches from the top of these tuyeres there are eight 2-inch round tuyeres. The blast pressure is 6 ounces and the charging door is 12 feet above the bottom plate. We average 5-ton heats and require hot iron for our work. Our charges are made up as follows: 900 pounds of coke on the bed and 2,700 pounds of iron; then successive charges of 300 pounds of coke and 2,400 pounds of iron. Twelve minutes after the blast is put on the first iron is tapped and the entire heat is taken off in about 1 hour and 20 minutes. Our melting ratio is approximately 5½ to 1. We would like to know whether we can reduce our fuel consumption by correcting our practice and would it be advisable for us to obtain a modern cupola. What melting ratio can we expect and still obtain hot iron?

Answer.—Your cupola was designed for the use of anthracite coal and you should elevate the tuyeres so that the bottoms of the openings are 12 inches above the sand bottom. Either add two additional tuyeres or increase the width of the front of each opening to 14 inches. The nearer the tuyeres approach a continuous belt the better will be the results. Close the 2-inch round tuyeres immediately. When you begin to charge, your bed coke should extend 15 inches above the top of the tuyere openings. I believe that you will be able to melt satisfactorily with charges consisting of 200 pounds of coke and 2,000 pounds of iron. You cannot very well reduce your melting ratio with only five tons of iron per heat, but you should be able to melt at a ratio of 6 to 1 and your heat should be taken off in an hour or less. It might be advisable to experiment as follows: Close the upper tuyeres and have the coke bed extended 15 inches above the tuyeres. Ascertain how much fuel you use and make subsequent charges in a ratio of 10 of iron to 1 of coke. If you find that your melting practice improves increase the blast pressure to 10 or possibly to 12 ounces.

A reprint of a paper presented by H. D. Gates, of the Mott Sand Blast department of the De La Vergne Machine Co., New York City, before the Associated Foundry Foreman of New York and vicinity is being distributed to the foundry trade.

Institute of Metals Has Successful Meeting

Many Papers Presented on Brass Foundry Practice, Metallurgy of Non-Ferrous Metals and Allied Subjects

ATTENTION at the technical sessions of the American Institute of Metals was directed chiefly to subjects relating to the metallurgy of the various non-ferrous metals and in particular to the use and possibilities of the electric furnace in melting these metals and their alloys. Papers on rolling mill practice, die castings and nomenclature were presented, and there were numerous reports in regard to the results of research work in laboratories. The institute also held two joint sessions with the American Foundrymen's Association; these are covered elsewhere in this issue.

The report of the official chemist, Arthur D. Little, Inc., included a survey of the progress in the non-ferrous metal industry during the past year. While no serious failures have resulted, said the report, it is true that the industry as a whole has not enjoyed any great degree of prosperity. The readjustment incident to the new tariff and currency acts, the Mexican menace and the uncertainty regarding further anti-trust legislation undeniably have played a part in the depression. This condition is world-wide in its scope, and the impression rapidly is gaining strength that the fundamental cause is due to the necessity of adjusting man's social and economic relationships to the profound changes which the past century has produced in our industrial life. To an optimist it is a condition of great future promise and the forerunner of an era of sounder and greater prosperity than ever before. "Surely," the report continues, "it must be evident to one familiar with the metal industry that present use of non-ferrous metals is too diversified and the rapidly extending demand too great to long prevent resumption of normal conditions. As a natural result of the feeling of unrest, the past year has witnessed comparatively few notable advances in the art. About the usual number of new alloys and processes were patented but attention has been directed more to working out details of present processes and improving upon old methods than to blazing new trails."

Considerable discussion was evoked by a paper on "Progress in the Nomenclature of Alloys", by G. K. Burgess. In this paper the author recommended that the advisory committee of the institute give consideration to the recent report of the British Institute of Metals in regard to nomenclature. M. K. B. Patch favored a conference with a committee of the British Institute of Metals in reference to this subject, saying that a standardization of names in this country would only lead to confusion unless it were adopted simultaneously in all other English speaking countries. W. H. Bassett thought it advisable to discourage proper names in naming metals. H. W. Gillett favored the use of numbers in denoting specific alloys. A number of speakers, including E. A. Barnes, of the General Electric Co., G. H. Clamer, of the Ajax Metal Co., and others favored Mr. Gillett's suggestion stating that the system of identifying various alloys by means of numbers had been in use by their respective companies for many years with very satisfactory results. A motion was carried asking that the advisory committee consider the question of standardizing names of the various alloys at its fall meeting.

The New Officers

President.

G. H. Clamer, Ajax Metal Co., Philadelphia, re-elected.

Vice Presidents.

R. B. Wallace, National Cash Register Co., Dayton; Robert Job, Milton-Hersey Co., Montreal; W. G. Harris, Canada Metals Co.; Jesse L. Jones, Westinghouse Electric & Mfg. Co., Pittsburgh; George C. Stone, New Jersey Zinc Co.; W. H. Bassett, American Brass Co.; Fred Moerl, Pullman Co.; J. G. Kasjens, Brass Foundry Co., Peoria; H. W. Gillett, Bureau of Mines, Ithaca, N. Y.; E. B. Horne, Packard Motor Car Co., Detroit.

Secretary-Treasurer.

W. M. Corse, Titanium Alloy Mfg. Co., Niagara Falls, N. Y., re-elected.

E. A. Barnes read a paper on "Drop Pouring Process of Casting". The author described a method he had followed in producing certain large navy bronze bell castings, averaging 239 pounds apiece. Owing to the size, weight and peculiar shape of the castings, it was decided at the outset to use the match mold process. At first the regular method of pouring from crucibles was tried, but as a result of porosity, cold shots and other blemishes, it was decided this method of procedure was incorrect. The drop pouring method was finally adopted and as a result only 2 per cent of the resulting castings went into the discount. The paper described in detail the equipment used.

De Courcy Browne submitted a paper on "Some Recent Applications of Metallic Cobalt". This described the results of tests on manganese bronze ingots, to which 50 per cent cobalt had been added. This test, the author said, showed that the addition of cobalt considerably reduces the tensile strength but at the same time increases the elongation and reduction of area.

Jesse L. Jones submitted a paper entitled "Bull Run Talc". The use of graphite or plumbago in foundry facings of high quality has been universal in the past, but there recently has been a very remarkable increase in the price of graphite and foundrymen for this reason have been looking for a satisfactory substitute, and in this connection he mentioned Bull Run talc, which now is being used extensively by many brass, gray iron and malleable iron foundries.

Charles Pack presented a paper entitled "Modern Die Casting Practice". This recounted developments in the die casting process and particularly described alloys which now are being used commonly in producing die castings.

At a special session devoted to rolling mill practice, two important papers were presented by A. B. Norton. One of them described a new hot shortness testing machine for aluminum alloys, while the other was devoted to a method of making aluminum test specimens. The test machine described is very simple in principle. A test specimen is cast in the sand in such a manner that as it contracts during solidification it lifts a weight, previously supported, or cracks in the attempt. Other conditions being the same, the metals which withstand the greatest stress without cracking show the least tendency to crack in the foundry. The method of preparing test pieces also was described. Mr. Norton conceded that aluminum test specimens should be attached to the castings. In discussing this paper, E. B. Horne stated that even if a test bar is put on a casting, it is possible to influence its physical characteristics so that they will differ from those in the metal of the casting itself. If the metal

passes through the casting to form the test bar it will show more strength, due to the fall in temperature, than where the metal enters the test bar direct without first passing through the mold.

C. P. Karr presented a paper entitled "Standard Test Bars of Zinc-Bronze, Copper 88, Tin 10, Zinc 2". Mr. Karr described a series of investigations made, first, to discover the most suitable temperature at which bronze should be poured to secure uniformly high tensile strength and ductility; second, to ascertain the most desirable methods of molding; third, to obtain a method of gating so as to avoid undue shrinkage in the castings and the production of internal stresses during solidification; fourth, to ascertain what shape of casting, if any, could be depended upon to secure the best results; fifth, to compare the results obtained in sand and chill molds, and sixth, to determine the effect of heat treatment on the properties of the metal. The results of the tests, he said, showed that the pouring zone most favorable to good results lies between 1,120 and 1,270 degrees Cent.; dry sand molding is recommended, the castings being poured either flat or vertical; the strengths of the chill and sand cast test bars are almost equal when the chill bar has been subjected to an annealing temperature of from 500 to 700 degrees Cent., but otherwise the chill bar is inferior to the sand test bar; heat treatment is productive of increasing ductility.

In discussing this paper, M. K. B. Patch said that the first essential in getting a good test bar is to feed the metal properly into the casting. G. H. Clamer was of the opinion that it was impossible under any circumstances for a test bar to show the same characteristics as the metal in the casting. In order to get as good a test bar as possible he recommended that the test piece be attached to the casting or that at least it be cast in green or dry sand according to the kind of mold used in making the casting. H. W. Gillet said that chilled bars were desirable only for use in determining the properties of alloys, and that he would not recommend their use for indicating the characteristics of sand cast castings.

A New Method of Analysis

G. E. F. Lundell and Mai Kim Bee presented a paper entitled "A New Method For the Determination of Zinc in Alloys". By this method such determination may be made in a period of 1½ hours.

Following the reading of this paper F. H. Schutz took occasion to describe a method which he recently devised for successfully turning out aluminum castings capable of withstanding a pressure of 300 pounds per square inch. In making these castings of No. 12 aluminum he obtained satisfactory results by using nitrate of potash as a flux. G. H. Clamer expressed his surprise at the success of this method as he had been of the opinion that it was not good policy to add a flux. C. P. Karr confirmed Mr. Schutz's experience and told about experiments he had made by adding salamoniac to aluminum. This flux he said had failed, but later he found chloride of zinc produced very excellent and uniform results. It is very important, however, that the chloride of zinc be absolutely dry.

Season Cracks in Forgible Brass

Ernst Jonson submitted an important paper on experience with forgible brass during the construction of the Catskill aqueduct. Season cracking, he said, is not always due to decrease in the strength produced by sudden exposure to low temperatures; but in some cases to the corrosive action of the weather. Certain kinds of corrosion, said Mr. Jonson, greatly reduce the cohesion of the affected part of the material thus destroying the ductility.

V. Stillman submitted a paper on "Brinnell Hardness Testing of Non-ferrous Alloys." Edward J. Gutsche read a paper entitled "A Brief Visit to a Brass Rolling Mill." This described the process ordinarily used in producing rolled brass products. A paper by W. W. Rogers suggested that in handling rolling mill scrap, old material of known composition stored in the bin should not be looked upon as so much alloy, but as so many pounds of raw material available for immediate use. If, for instance, a bin contains 10,000 pounds of 10 per cent German silver scrap, it should be considered as 6,000 pounds of copper, 1,000 pounds of nickel and 3,000 pounds of zinc.

Several important papers relating to metallurgy and metallography in connection with non-ferrous metals, were presented. They embraced copper, spelter, tin and antimony. One of the most important was that on copper by Lawrence Addicks, of Phelps, Dodge & Co. The title of this paper was "Commercial Classification of Copper." Mr. Addicks described the various forms in which copper appears in nature and the three general methods which are employed in converting copper ore into crude or refined copper. He also described the electrolytic and fire methods of refining, and discussed in considerable detail the characteristics and properties of lake, electrolytic and casting copper. The writer devoted considerable attention to the various elements which occur as impurities in refined copper and described the effects exerted by each of these elements.

Following the reading of Mr. Addick's paper an interesting discussion developed in regard to the selling price of lake copper. G. H. Clamer started this discussion by inquiring of W. H. Bassett, as representative of the largest consumer of copper in the country, why lake copper sells at a premium over electrolytic, if, as Mr. Addicks had contended, lake copper contains no superior qualities. Mr. Bassett stated that this question had been much discussed among the large consumers of copper and that the general opinion on the part of these interests is that lake copper should sell at the same price as electrolytic. The lake producers, however, claim superior qualities over electrolytic and hence uphold the premium asked on lake. It is claimed lake copper is of a fibrous nature which gives rise to greater ductility and tensile strength, but this matter is open to considerable argument. Mr. Bassett stated that in his opinion the best results in purchasing copper may be obtained by doing business with producers who are careful to turn out metal having good physical characteristics and that should equal care and supervision be exercised in the process of manufacture, either metal is acceptable.

Spelter Manufacture

Geo. C. Stone, of the New Jersey Zinc Co., submitted a paper entitled, "Spelter Manufacture and Its Properties." The writer, in considerable detail, described the practice which is customary among spelter producers in this country, illustrating his talk by means of numerous lantern slides, which showed the construction of retorts, condensers and other equipment. He gave the analyses of four grades of spelter which are most commonly used in this country: High grade, intermediate brass special and prime western. He also mentioned the impurities which are most commonly found in spelter and described the effects that are attendant upon the presence of each. Mr. Stone also submitted some very interesting data in regard to the production of "Slush Castings." These castings are made by pouring the molten metal into a chill mold and then pouring the major part of the metal back into the ladle, this process resulting in the production of a shell casting. The writer recommended that for the pro-

duction of such castings pure spelter be used exclusively, since the presence of other elements leads to defects. Lead when present, even in very small quantities, produces cracks as well as excessive weight in the casting. Cadmium has a like effect although the resulting cracks are not quite as noticeable as where spelter is used. The presence of cadmium, he stated, leads to the production of very brittle castings.

W. A. Cowan, National Lead Co., submitted a very interesting paper on the "Metallurgy of Tin and Antimony." He enumerated the sources of these metals and described the forms in which they occur in nature. He also recounted recent attempts which have been made by large consumers to get tin made to specification. On account of the inaccessibility of the producing districts but slow progress has been made in this connection. Mr. Cowan submitted analyses of samples of the best known brands of tin, taken at random, and the paper included methods of sampling tin and antimony.

F. O. Clements presented a paper entitled "The Effect of Repeated Remelting on Copper." A great many foundrymen, the author said, claim that many metals, especially copper, deteriorate in quality with each remelting. The author decided that the reason for this deterioration was the addition during remelting of impurities and he consequently made a series of tests to determine just what impurities were added during remelting. Starting out with virgin pure copper he found that after each heat the metal showed an increase in oxygen and sulphur, and tests made after each heat showed a constant and consistent deterioration in the physical qualities due to the addition of these elements. Following the fourth remelting, which resulted in a very low-grade metal, he added boron suboxide, in the ratio of two ounces of oxide to 16 ounces of copper, the metal being at a temperature of 1,263 degrees Cent. The addition of this flux, he stated, resulted in restoring the metal to its original state of purity.

Ternary Alloys

S. L. Hoyt presented a paper entitled, "Ternary Alloys of Copper, Tin and Zinc." This set forth the results of research work which the author described in a paper presented before the British Institute of Metals last year. This paper was based on two year's research which was conducted in determining the relative characteristics of binary and ternary alloys of the three metals. In general, the author stated, ternary alloys of these metals, up to 50 per cent zinc and 30 per cent tin, were observed, from microphotographs, to behave similar to the binary alloys. The paper recounted the discovery of an unknown heat effect in the pure copper-tin alloys and set forth the causes which lead to changes and abnormalties in the micro-structure.

Electric Melting

Dr. Herbert G. Dorsey, in a paper entitled "Tests on Electric Furnaces for Brass Foundries," set forth the experience of the National Cash Register Co. in using an electric furnace for melting brass. Originally the Cash Register company, in considering the installation of an electric furnace, made some investigations with the result that a resistence furnace was installed in preference to one of the arc type. The only resistence furnace which is was possible to secure at the time for melting brass was of the type known as the "Helberger," manufactured in Germany. The Cash Register company accordingly purchased a "Helberger" furnace and experimented with it for some time. The company ran 55 different heats but encountered considerable trouble due to the failure of the crucible to stand up under the work, to impurities in the metal traceable to the crucible, and to certain inherent disabilities in the operating principle which rendered its use impracticable in melting brass on a large scale. It is possible the Cash Register company may make certain changes in its construction, to the end that its efficiency may be increased.

Ernst M. Schmelz submitted a paper describing a new type of electric furnace, which is recommended for use in melting non-ferrous metals and alloys. This furnace is an evolution of the well known Stassano furnace. The double chamber, which was a feature of the Stassano furnace designed to treat copper ore, has been done away with and the thermal efficiency increased. The new furnace can be designed for the use either of direct of alternating current, single or three-phase, the pressure varying from 75 to 220 volts, according to the size of the furnace. The number of cycles is immaterial. The author sets forth figures obtained from the Titanium Alloys Mfg. Co., Niagara Falls, N. Y., which in operating a furnace of this type, melted 1,000 pounds of red copper in less than two hours, using current at the rate of 0.12 kilowatt-hours per pound.

The interest manifested in the future of the electric furnace by electric power companies who hope through the development of such apparatus to open up a new field for the disposal of current in off-peak hours, was reflected in a paper submitted by H. M. St. John, Commonwealth Edison Co., Chicago. Mr. St. John stated that the results of experiments conducted by his company indicate that the electric furnace soon will come into wide use for melting non-ferrous metals and alloys. One advantage of the electric furnace, he stated, is that its use increases efficiency of the workmen because of improvement in working conditions, such as a cleaner and cooler atmosphere. The electric furnace, also, when operated continuously, may be operated at less cost than where fuel is employed. The experiments which the Commonwealth Edison Co. conducted were made in connection with two distinct types of furnaces, the "crucible lift-out" type in which the metal is melted in crucibles, and the "tilting type" in which the metal is melted in the furnace chamber and poured into a heated ladle when ready for use. In general, said Mr. St. John, the tilting type is the more efficient, but for certain purposes the crucible type is preferred despite its lower efficiency. The best results are obtained in continuous operation; the electric furnace is at a serious disadvantage if it is operated only 10 hours per day and allowed to cool off over night. Much of the heat is lost through radiation while the furnace is standing idle and must be replaced on the next day's run to bring the furnace up to operating temperature. In a recent experiment it was found that more than 30 per cent of the power supplied during the day's run, starting with the furnace fairly hot from the preceding day, was absorbed by the refractories and lagging while the furnace was brought to a thermal equilibrium. Mr. St. John submitted data showing the results and detailed costs obtained in operating these two types of furnaces on both red and yellow brass.

Melting Practice

H. W. Gillett, of the bureau of mines, Ithaca, N. Y., opened the session on melting practice by reading a paper on "Melting Losses in Electric Brass Furnaces." In their work Mr. Gillett and his associates have not sought to test one type of furnace against another, but simply to determine from experiment if any type of furnace using the electric current for heating can make sufficient saving in metal losses to overcome the high cost of current under present conditions. With development of electric furnaces and cheapening of current

that will follow further research on the part of engineers he believed a point will be reached where their use will be a great economy. With indirect arc furnaces, it was found metal losses are no less than in fuel fired furnaces. In furnaces of tilting reverberatory type, where the resistor is over the metal, producing a diffused flow of current through the electrodes, the losses were found to be about 0.75 per cent. A crucible lift-out furnace, with means for closing it tightly, was used and the heat was found to be uniform. Also the vapor of the metals did not escape. In melting about 2,500 pounds of brass with 16 per cent zinc, the loss was 0.75 per cent. On melting 1,500 pounds of yellow brass ingots the loss was found to be 0.50 per cent. On copper ingots and phosphor bronze no loss was detected. The conclusion from the tests was that losses in the electric furnace range from one-third to one-half those in a fuel fired furnace. The conclusion is reached also that 75 per cent of the losses occur in pouring. Eventually, he believed, improvements will make possible the economical use of electric furnaces, thus doing away with great losses of metal under present conditions.

Several other papers were read by title and a short discussion followed. E. R. Guenther presented his paper on "The Use of Producer Gas for Melting Yellow Brass," in which he gave results of using this fuel instead of fuels heretofore employed. High efficiency has been attained and experiments have shown this gas is excellent for the purpose; it can be used at low pressure, with or without preheating.

Natural Gas Furnaces

Fred L. Wolff gave briefly his conclusions as embodied in his paper on "Tests of Natural Gas Fired Furnaces Under Factory Conditions." The matter of a proper burner has been given much attention, but no definite recommendation yet can be made. Cheapness of natural gas in regions where it is obtainable commends it, but the precariousness of the supply prevents costly equipment being built for its use. The unusual volume of air it is necessary to mix with natural gas makes the matter of regenerators a difficult problem.

H. W. Gillett spoke briefly on the subject of pyrometers for brass foundry work, the result of long experiments being that while progress has been made in this line there still is room for much improvement in this method of measuring high temperatures. His paper, he admitted, was largely negative, showing failures of measuring devices to give results in short enough time to be of value.

G. H. Clamer described briefly a type of electric furnace in use for brass melting which has been giving excellent results. In this form, the heat is applied from the bottom of the bath and is conserved by unusually thick walls. Data which he submitted showed an average of 38 cents per hundred pounds as the cost of melting brass in a coke furnace, while in this particular electric furnace the cost is but 20 cents per hundred pounds.

A Hot Shortness Testing Machine for Aluminum

By A B Norton

IN INVESTIGATING the causes of the cracking of aluminum castings, the research department of the Aluminum Castings Co., Detroit, found it essential to have some simple means of measuring the strength of metals during the solidification period. This necessity resulted in the invention of the hot shortness tester. The machine was developed by H. W. Gillett and V. Skillman in 1911, and has been is use since that time. A somewhat similar device has been developed by Turner and his students, the latest form of which is described in the *Journal of the Institute of Metals* (British), Page 204, Vol. 10 (1913), but the device of Turner is designed only to show the expansion or contraction of the metal during solidification, not to measure its strength during that period.

The principle of the machine is simple. A test specimen is cast in sand in such a way that as it contracts during solidification, it lifts a weight, previously supported, or cracks in the attempt. Other conditions being the same, the metals which withstand the greatest tension (lift the greatest weight) without cracking, show the least tendency to crack in the foundry.

In determining the type of test piece to be used, it was desired to get something which would crack rather easily. The shape chosen, therefore, was a round piece, ¼-inch in diameter and 2 inches long, connected, unfilleted, to the ends of two cylinders, 5 inches long and 1 inch in diameter.

The test piece is cast horizontally in an iron flask, the dimensions of which need be only 5 x 16 inches and 6 inches deep. It is gated at one end and has no riser, since that would tend to prevent cracking.

Contracts of Test Price

In the gate end of the test piece there is cast a bolt, which is fastened rigidly to the flask. This holds the test piece stationary when contraction starts.

Tension is applied to the other end through a bolt, also cast in the test specimen. This bolt screws into a lug, to which is fastened a flexible wire cable. The cable runs over a pulley and carries the scale pan. A slotted arm, projecting from the drag, supports the lug and prevents the pull of the scale pan from acting until the shrinkage of the metal either draws the lug away from its support or cracks the specimen.

The test piece, being cast without riser, commonly shows a shrink in the end, opposite the gate. This shrink is desirable, since the consequent contraction aids materially in providing the stress, which is needed either to raise the weight or cause a crack.

In operation, it is essential to have the molds prepared and poured as nearly as possible under duplicate conditions. Different tensions, ranging from 25 pounds up, are then tried on the alloy under test. The largest load this alloy will raise without cracking is the figure taken for comparison.

The results obtained by the use of this apparatus have been valuable in pointing out the probable tendency toward cracking of different alloys and different lots of metal. One lot of pure aluminum made into No. 12, may fail to withstand a tension of 25 pounds, while another lot of the same chemical composition and poured at the same temperature, may raise a weight of 225 pounds without cracking. The former generally will be found to be much more difficult to handle than the latter. Widely varying results have been obtained in

*Presented at the Chicago meeting of the American Institute of Metals.

testing alloys of different compositions and the conclusions drawn from experiment check well with foundry experience.

Outerbridge, in a paper originally published in the *Journal* of the Franklin Institute and entitled "Integrity of the Tests of Metals," states some of the general problems involved in obtaining satisfactory and representative test specimens of metals in general. At present this remains, for the most part, an open question with which various technical societies, producers and consumers are struggling.

The problem with aluminum alloys is now much nearer to a satisfactory and complete solution than is the case with non-ferrous metals of higher melting points. This is due principally to the fact that pyrometers for this class of work are well developed, and hence the study and standardization of the conditions involved have been much facilitated.

It is generally conceded that an aluminum test specimen should be made on the casting the properties of which it is supposed to represent, as is specified by the Society of Automobile Engineers. It will then have the same composition and be subject to the same pouring conditions. The most important variable affecting the strength of aluminum castings made from the same pot of metal, is the pouring temperature. In order to get test bars on castings, a simple method of molding is in use in the foundries of the Aluminum Castings Co. This method can easily be adapted to any class of work.

The test specimen used is the standard form specified by the Society of Automobile Engineers. It is cast in a green sand core, which is placed in the drag and gated onto the casting along the parting line. This core is in the shape of a rectangular prism, giving a decided taper and laid on its narrowed side. The taper for the drag half of the core is a continuation of the cope taper, so that the two parts can be lifted together from the core box.

Test Bar Pattern

The test bar pattern is about three inches longer than the core box. It projects out of openings, resembling split bearings, in the core box end. Lugs on either end of the pattern permit its rotation without danger of its being moved lengthways.

The preparation of the small core is a simple and ordinary process. An anchor plate is placed on the bottom board, inside the drag, and two screws, long enough to project above the cope, are screwed into this. The pattern is then set in position and the drag half is made up, the parting line being along the center of the test bar. The cope is next put on and rammed. After rotating the pattern and removing the screws, the cope is lifted off, the pattern is drawn and the mold is closed. The screws are replaced and the core is lifted out on the anchor plate, ready to be placed in the mold.

The print in which this core is to be set is prepared during the process of ramming the drag. A pattern of this core, with gate forms at both ends, is rammed in the drag, with its upper surface flush with the parting line. The core pattern is drawn and the core inserted in its place. Then all that remains is to cut a gate to the casting at the desired point and cut risers in the cope.

Although developed primarily for use on aluminum castings, it might be pointed out that the method described in this paper can easily be adapted to use with other alloys, if an attached test piece is found desirable. The same idea, with slight modification, can be used also in obtaining other forms of test coupons on castings, and its ease and rapidity of manipulation recommend it for this purpose.

Progress in Nomenclature of Alloys

By G K Burgess

SINCE last year's meeting of this Institute, which endorsed the suggestion to take up the subject of standard designations for alloys, careful attention has been given to the subject in several quarters. The most important and far-reaching development in this connection has been the first report to the British Institute of Metals of its committee on the Nomenclature of Alloys on which were representatives of six other British technical societies.

There are two fairly distinct aspects of this nomenclature question. First, we have to consider the naming of the alloys themselves in terms of their component chemical elements or otherwise, and second, the naming of the metallographic constituents which are recognized as accompanying certain chemical or physical properties of the alloy and characterizing the distribution and relation of the elements to each other in the alloy. Or, in short, it is necessary to provide names for the composition of an alloy and for the arrangement of the constituents in the alloy. Although, in general, they are distinct, there may arise overlapping in the nomenclature of the alloys and their metallographic constituents, so that both aspects of the subject should be kept in mind when either one is being specifically considered.

The report to the British Institute of Metals is confined to the first phase of the subject, the naming of the alloys, and lays down the following guiding principles:

(1) So far as names intended for use in industrial and commercial practice are concerned, it is desirable to adhere to existing names sanctioned by long usage as far as possible, provided that all such names can be so defined as to avoid all risk of confusion or ambiguity.

(2) The coining of new names or the adoption of recently coined names not in general use should be avoided as far as possible.

(3) It is desirable to employ simple English names throughout, avoiding the use of Latin or foreign names, and of chemical or other symbols.

The principle adopted for the construction of a system of nomenclature "is that of denoting any alloy by the names, in English, of its component metals, placed in the order of increasing numerical importance from the point of view of chemical composition by weight." When two or more metals are present in nearly equal amounts they should be placed in alphabetical order. "Where an alloy consists of more than three metals its systematic name shall not, as a rule, contain more than the names of three metals present in the largest proportion by weight, but the presence of additional metals or elements shall be denoted by the prefix *comp* or *complex*. If however, an alloy of this kind contains an intentionally added element which, although present in small quantity, gives the alloy a distinctive character, that element may be named first."

The report ignored the question of tolerances and considered as beyond its province the questions of impurities and specifications.

Two very important classes of alloys are named: (1) "The term *brass* is to be used as an abbreviation of the words *zinc-copper* as employed in the systematic nomenclature. Thus, when the word *brass* alone is employed it shall denote an alloy of zinc and copper only,

*Presented at the Chicago meeting of the American Institute of Metals.

containing more copper than zinc, that is, containing over 50 per cent of copper. When an alloy containing a third metal, such as tin, is to be denoted, the name of the additional element shall be used as a prefix, precisely as in the systematic nomenclature. Thus an alloy containing tin, 1 per cent, zinc, 29 per cent and copper, 70 per cent would be called *tin-brass.*"

(2) Similarly the term *bronze* is held to mean *tin-copper.*

The advisory committee to the Bureau of Standards on non-ferrous alloys, comprising representatives of this Institute, the American Society for Testing Materials, the American Chemical Society and the American Institute of Mining Engineers, at a meeting held on April 14, together with representatives of that Bureau, considered the British committee's report, and it was the opinion of those present "that this report was conservative and satisfactory so far as it went, although it contains one recommendation not in accord with general practice in the United States, namely the order of names in an alloy to be in order of increasing numerical importance. It was the consensus of opinion of the committee that it would be highly desirable for the American societies interested and the Bureau of Standards to co-operate with the British Institute of Metals in this question of nomenclature of non-ferrous alloys."

It will be noted that there are many points of resemblance between the principles laid down in the British report and the suggestion made by Mr. Karr in a paper presented at last year's meeting of this Institute. It would probably be well to avoid the term *composition* as used by Mr. Karr for systematic names and leave it for use as a convenient expression for an alloy containing three or more components, including always copper, which latter practice is common in America. Thus any alloy of copper, tin and zinc might be called a *composition,* but the systematic name of the Zn 2-Sn 1--Cu 88 would be *zinc-bronze* and the alloy with Sn 2-Zn 10-Cu 88 would be *tin-brass,* in accordance with the proposed British nomenclature. If now manganese and iron are added to this tin-brass and the manganese contributes markedly to the resulting properties we should call the resulting alloy of composition Mn 0.5-Fe 1.0-Sn 2-Zn 10-Cu 86.5 a manganese *complex* brass in the British notation. German silver may still be called such but it might also be classed as a nickel-brass.

Use of Abbreviations

Dr. Guertler, following others, suggests abbreviating the names of the elements making up an alloy and, for binaries, combining these abbreviations into a single word, the preponderating element being named last. Thus he would say *cupral* for copper- aluminum and *alcup* for aluminum-copper. He gives a complete list of prefixes and suffixes.

This Institute is primarily interested in the first aspect of the nomenclature question that is, the naming of the alloys. In view of the conservative nature, reasonableness and practical simplicity of the principles advocated in the report of the British committee, and for the sake of uniformity of usage, which is most desirable of attainment it, would appear advisable for this Institute to adopt the British suggestions on non-ferrous nomenclature.

It would also appear worth while for the Advisory Committee to the Bureau of Standards on non-ferrous alloys to continue the consideration of this subject. There are several questions related to nomenclature which have not yet received sufficient attention, such as tolerances for allowable limits of components in definitions of different classes of alloys; tolerances as to impurities allowable without modifying the name; and standard specifications for the several classes of alloys and suitable tests for their fulfillment; all of which, and many related questions, are of the greatest practical importance.

PROBLEMS OF THE BRASS FOUNDER

What To Do and How To Do It

Use of Scrap Copper

Kindly advise me if there is any method for cleaning old copper, such as old trolley wire, tea kettle bottoms, copper washboilers, coffee cans, etc. Can this class of copper be properly cleaned so as to make good, clean castings?

The trouble with scrap copper is that it is liable to be contaminated with iron and castings made therefrom are black and unsightly when removed from the sand. The remedy is to remove the iron before the copper is melted, which, in the case of old bottoms, is somewhat difficult of accomplishment, as the iron usually exists in the form of a wire enveloped in the seam at the juncture of the copper bottom with the iron sides of the vessel. It will be difficult and expensive to open these seams and remove the wire and, therefore, such material is used largely for making car journal bearings, as a little iron in these castings causes no difficulty. In this instance, a good plan would be to cut off the seam and to use the clean copper in the center of the bottom for making the better class of castings. Salvage the copper from the seams by melting at as low a temperature as possible and carefully removing the iron wire. Later, ingot the metal for use in castings for work that is not unusually particular. The iron is the cause of discolored castings and the remainder of the dirt on the copper is largely carbon and oxide, the former doing no harm, but the latter should be reduced by use of phosphor-copper in the proportion of ¼ to ½ pound per 100 pounds of metal melted.

Hard Brass Mixture

We have received an order for brass nuts that will be subjected to hard wear and we would like to have a mixture for brass of sufficient hardness to make it practically impossible to machine.

An alloy consisting of 80 per cent copper and 20 per cent tin probably will be found satisfactory for this work.

Use of Scrap Bearing Metal

We have been pouring hub plates on driving wheels, but they break when cool, notwithstanding the fact that we have used asbestos packing around the journal. In using scrap bearing metal, what new metal, if any, should be added to it and would it be advisable to employ phosphor-copper in the mixture? Also we would like to have a formula for engine bearings.

Probably the bearing metal is too high in lead for the purpose outlined and we would suggest a trial of the following alloy: Copper, 88 per cent; tin, 8 per cent; zinc, 2 per cent and lead, 2 per cent. If the analysis of the scrap metal is known, a proportion of new metal of the same mixture can be mixed therewith and will result in improving the alloy. Fifty per cent scrap and 50 per cent new metal is a good proportion to employ. The addition of 0.5 per cent phosphor-copper to scrap metal when remelting is advisable.

The Drop-Pouring Process of Casting Bronze

How Large Phosphor-Bronze Sections Were Cast Successfully by This Method After Other Attempts Had Failed

By E. A Barnes

ONE of the most difficult problems that ever confronted the writer was the successful production of large navy bronze castings, averaging 239 pounds each, in the form of smooth hemispheres with the poles dished in for perhaps one-half the hemispherical depth, as shown in Figs. 4 and 5, respectively. These bell-shaped castings are peculiar in cross-section in that they have a heavy webbed hub which shades into a very thin wall, which in turn is bounded by a heavy rim or periphery whereby two such hemispheres are screwed together, forming a spherical unit.

Due to the size, weight and peculiar shape of the castings to be produced, it was decided at the outset to use the match mold process, rather than the regular process, in which both the inside and outside of the pattern is used for molding or printing purposes. The patterns were therefore mounted on suitable metallic follow-boards and equipped with mathematically correct locating pins which fitted receptacles in the special metal flask bodies, Fig. 3.

This process, as is well understood, eliminates the cope, both parts of the mold virtually being drags, but of different forms and size, so that when placed together the intervening space is of the exact dimensions of the casting desired.

The molds are made from specially prepared sand and are faced with graphite and cement, Prussian red or some other modern facing. The molds are baked in a drying oven for about 8 hours at a temperature of 650 degrees Fahr. to remove the moisture. When the molds are assembled ready for the casting process, the runners and risers are stopped with oiled tissue paper to prevent as far as possible the entrance of moisture from the damp air of the foundry.

In the first attempt at making these castings the regular method of pouring from crucibles was tried, but after making many castings—all of which were defective due to porosity, cold shots and blemishes generally—it was decided that the method of casting was wrong. Many practical foundrymen and experts were consulted who suggested other mixtures, the use of phosphorus, phosphor-tin, phosphor-copper, patent fluxes and deoxidizers. All of the suggested plans were tried out but with practically no better results. It was therefore determined to try the drop-pouring method of casting and since its adoption we have enjoyed a production of 98 per cent good castings with the molding, baking and other operations remaining the same as originally planned.

Naturally it took quite a little experimenting to work out the details, to determine the best size and number of runners, risers and pouring heads because of the uneven cross-section

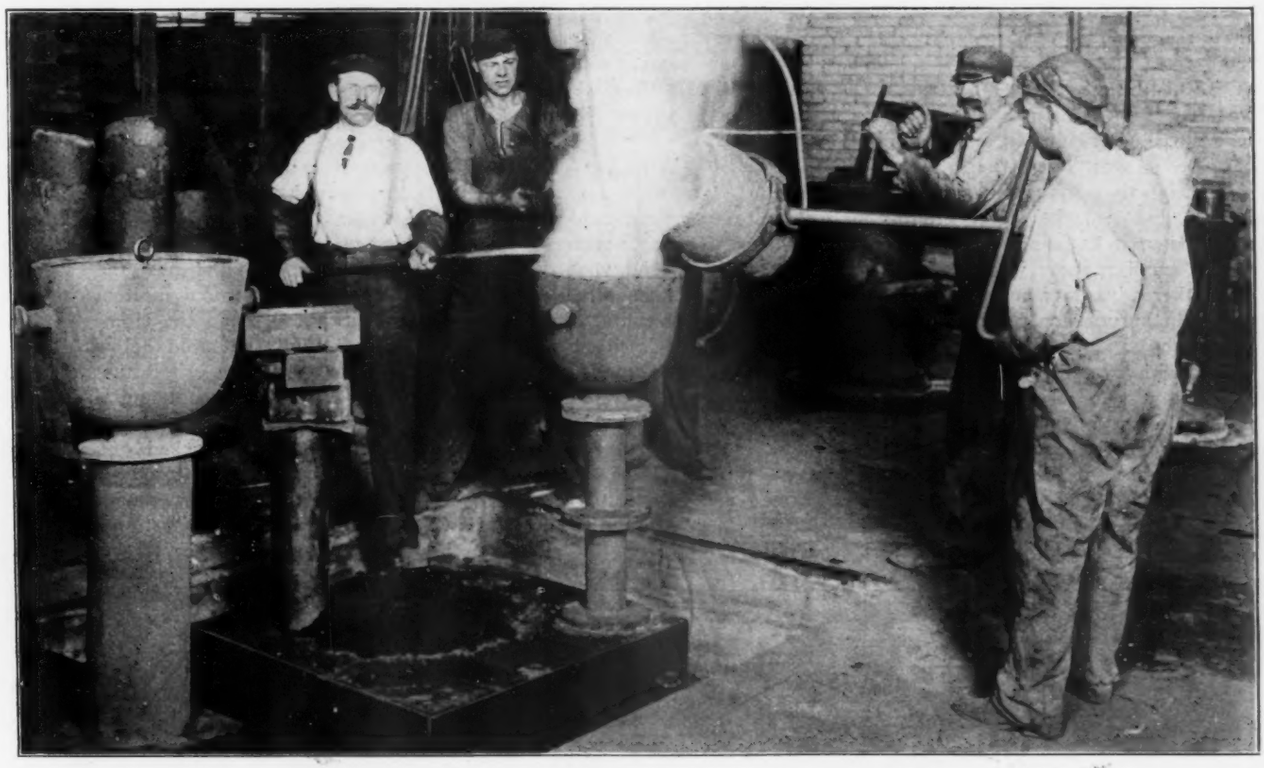


FIG. 1—POURING BRASS CASTINGS BY THE DROP-POURING PROCESS

A paper presented at the annual meeting of the American Institute of Metals, Chicago, Sept. 8-11, 1914.

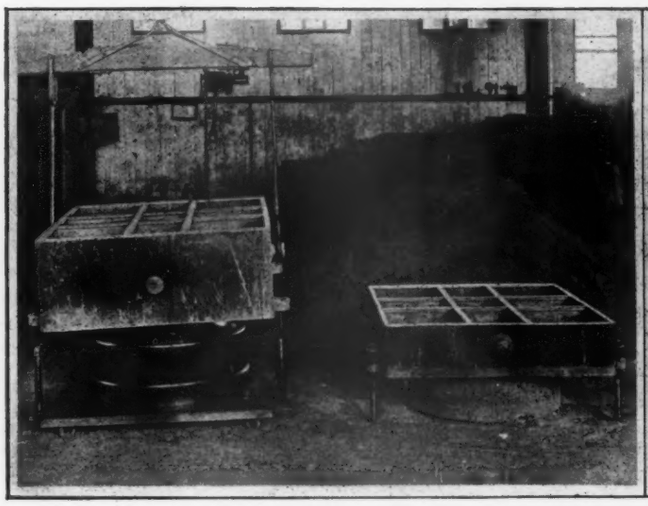


FIG. 2—PATTERNS FOR SMOOTH SPHERICAL CASTINGS

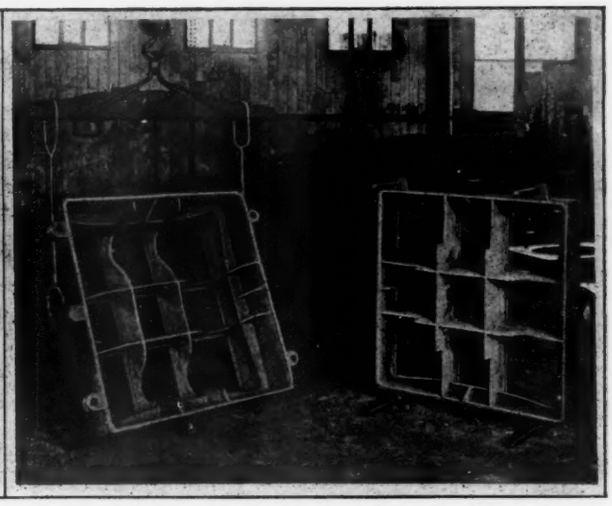


FIG. 3—PATTERNS FOR SPHERICAL CASTINGS WITH POLE PIECES

of the casting. The original theory worked on was that the heavy ring of the bell should be fed with a heavy riser. Experience, however, proved that the shrink head was at times fed from the heavy ring and at other times the heavy ring was fed from the shrink head. Therefore small risers finally were adopted because it was found best that the metal in the runners should chill quickly and seal the metal within the mold when it had once entered. The use of small runners was found to be of further advantage in that the light nicked-in sprues could be quickly removed by a blow from a hammer, while with the heavy runners and gates it was necessary to resort to the use of a power saw to remove sprues from the castings.

The size of the flask in which these bells are cast is approximately a 4½-foot cube; the height of the riser and overflow tubes used is about 2 feet; the casting pot adds about 1½ feet more to the height; therefore it was found necessary to locate the flask in a pit so that, as a convenience in pouring, the top of the receptacle for the molten metal would come not more than 3½ feet above the floor level. This is shown clearly in Fig. 1.

Cast Iron Pots

The casting pots used are made of cast iron and are not lined with any refractory material, but instead are painted with a suitable stopping-off mixture. The vent at the bottom of the casting pot is fitted with a stopper or valve of machine steel into which an eye bolt is screwed to make its extraction an easy matter.

The pouring operation is carried out as follows: The flask is first assembled in the pit and the riser tubes are put in place and cemented with suitable cement to the sand of the mold. The joints between the pouring pot and the riser tubes also are cemented.

The stopper is now inserted in the casting pot and the necessary amount of molten metal is poured in. Both the casting pot and the crucible from which the metal is drawn are kept covered with hard wood blocks to reduce oxidation as much as possible. As soon as the metal in the casting pot has become quiet the boss molder inserts a bar in the eye bolt of the stopper and withdraws the stopper quickly. The entire molten contents of the pot descend the riser pipe rapidly and fill the mold below.

A few minutes after the mold is poured the casting pot and riser pipes are removed and the metal remaining in them is knocked out while it is yet in a red hot condition so it can be returned at once to the crucibles and be mixed with new metal for the next run. No haste, however, is

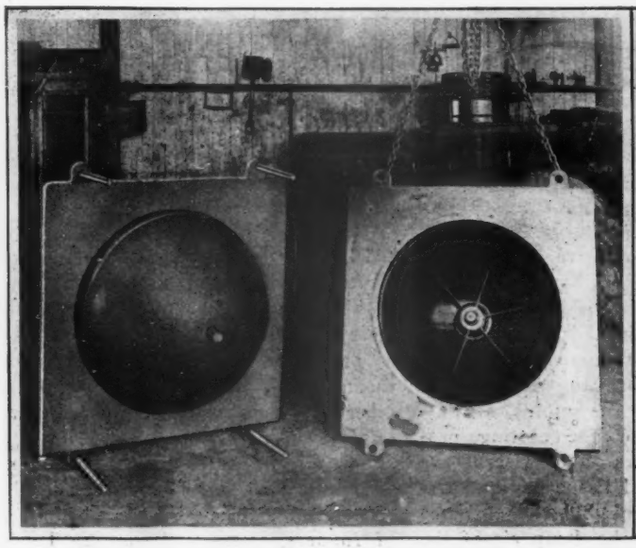


FIG. 4—SPECIAL FLASKS FOR SPHERICAL CASTINGS

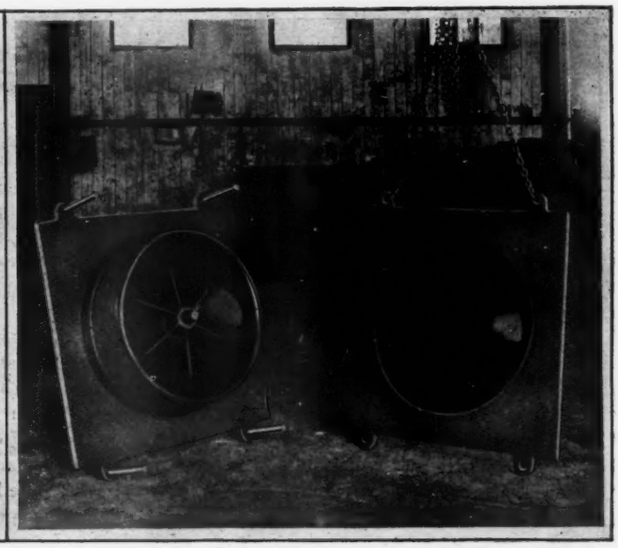


FIG. 5—THE FLASKS HAVE SPECIALLY SHAPED BARS

exercised in the removal of the casting from the mold.

By the use of microphotography we have ascertained that it is of great advantage to anneal these castings. Any tendency toward porosity in the fillet at the junction between the heavy and light sections seems to disappear with annealing. In proof of this fact two microphotographs are submitted herewith. The micrograph shown at the left, Fig. 6, was taken from a section of the rim of one of these bells before the casting had been annealed. The micrograph shown at the right, Fig. 6, was taken from a section of the same piece after it had been subjected to an annealing process for one hour at 700 degrees Cent.

It has furthermore been found of great advantage to dip these bells in a bath of tin kept at a temperature of 600 degrees Fahr., the casting being allowed to remain in the bath until it is thoroughly tinned and expanded. This operation seems to take out all the unnatural shrinkage and leaves the bells in much better condition to be machined and handled generally.

In conclusion we wish to emphasize the fact that we have thoroughly tried out the conventional methods of casting in the production of these large bell-shaped pieces, using all the knowledge that has come from a wide experience in brass foundry work, and trying out many different kinds of mixtures, but have found no combination of method and mixture that gives anything like the satisfactory results that we now obtain from the regular navy bronze mixture and the drop-process of casting, followed by the annealing or tinning as described. Visiting experts, after having looked carefully over the situation, have agreed with us that this plan is unquestionably the best solution of the problem. It has been an extremely interesting problem to solve, and we offer the results of our experience in the hope that it may be of help to some one who finds himself with a similar problem of producing perfect bronze castings of complicated form.

Record-Breaking Production of Aluminum

The year 1913 was the most prosperous in the history of the bauxite and aluminum industries in the United States, according to W. C. Phalen, of the United States Geological Survey. The production of bauxite in 1913 was 210,241 long tons, valued at $997,698, against 159,865 long tons, valued at $768,932, in 1912. Bauxite is used chiefly as raw material in the production of metallic aluminum, in the manufacture of aluminum salts, in the manufacture of bauxite bricks, and in the manufacture of alundum for use as an abrasive.

The amount of aluminum consumed in the United States in 1913 was 72,379,090 pounds, against 65,607,000 pounds in 1912. The marvelous growth of the aluminum industry is shown by a comparison of the 1913 output with the total consumption of aluminum during the last 20 years, 377,000,000 pounds. More than 329,000,000 pounds have been consumed in the last 10 years. The total production in 1884 was only 150 pounds.

Aside from its use in the manufacture of cooking utensils, aluminum is now being employed on a larger scale in the construction of welded tanks, cooking vats, and vessels used by brewers, preserve manufacturers, and fat recoverers, and in industries where a metal is required that will conduct heat, will not corrode, and is not poisonous.

The use of aluminum wire as a conductor in long-distance power-transmission schemes is increasing. A recently developed branch of the aluminum industry is the manufacture of the powdered metal known as aluminum-bronze powder, which is used extensively as a paint pigment, in explosives, in lithographing and in printing. Aluminum foil has partly displaced tinfoil for wrapping articles such as cheese, chocolate candies, and tobacco. One of the newest and perhaps oddest uses for aluminum is its employment in making the soles of shoes to be used by workmen employed in wet and damp places. The aluminum-soled shoe lasts much longer than an ordinary shoe and is impervious to dampness.

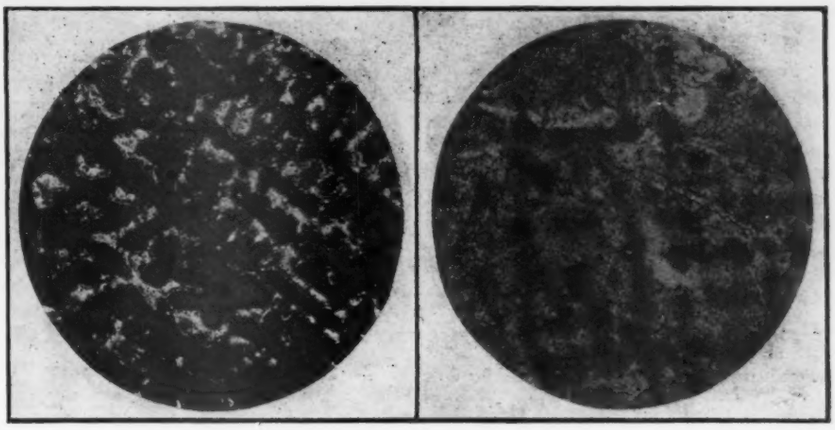


FIG. 6—MICROPHOTOGRAPHS OF ANNEALED AND UNANNEALED BRONZE —THE ANNEALED PIECE IS SHOWN AT THE RIGHT AND THE UNANNEALED AT THE LEFT

Varying Silicon in Malleable Iron

By A L Pollard

IT HAS been the custom, since first malleable iron mixtures were made up by analysis, to consider silicon as the element of prime importance. It is only recently that the effect of carbon has been studied carefully. The writer's attention was first called to this subject by the accident of a very low carbon heat. The test wedges from this proved to have such excellent quailties that it seemed to offer a most interesting field for investigation. A record was therefore kept of the analysis and physical properties of every heat for a period of eight months and the data then correlated to show the effect of varying carbon and silicon.

The physical test used was that devised by Mr. Walker and standardized by Professor Touceda. Wedges 6 inches long and 1 inch wide by ½-inch at the base were cast, and annealed with the regular castings. The annealing was normal and was the same in all cases, the ovens being brought up to 1,650 degrees Fahr. in 18 hours, held at 1,650 degrees Fahr. for 72 hours, and cooled for about 60 hours. The wedges were then placed upon the anvil of a small drop hammer, and were given a sufficient number of 70 foot-pound blows to fracture them.

The hard iron analyzed in every test about 0.175 phosphorus, 0.04 to 0.07 sulphur and 0.20 to 0.25 manganese. These elements therefore do not enter into this discussion. Only the carbon and silicon content was considered in gathering the tests into representative groups. There were of course variations due to im-

A paper presented at the Chicago convention of the American Foundrymen's Association, Sept. 8-11, 1914.

proper annealing, shrinks, etc., but these were eliminated, provided the fracture showed the effect conclusively.

The condensed results are as follows, the analysis being for the hard iron:

First Series:—
Carbon 2.30 to 2.40
Silicon .90 to 1.00—18 blows
Silicon .80 to .90—24 blows
Silicon .70 to .80—30 blows (1 test only).
Second Series:—
Silicon .90 to 1.00
Carbon 2.30 to 2.40—18 blows
Carbon 2.40 to 2.50—14 blows
Carbon 2.50 to 2.60— 9 blows
Carbon 2.60 to 2.70— 5 blows (1 test only).
Third Series:—
Silicon .70to .80
Carbon 2.64—15 blows (3 tests).

There was very little variation in the appearance of the above fractures. Most of them were dark gray with a lighter rim about 1/16-inch wide. The high silicon and high carbon fractures showed numerous crystals reflecting points of light. All samples were well annealed.

The physical properties as exhibited by the above tables, show uniformly high ductility on low carbon mixtures, and where both carbon and silicon are low the properties are unusually good. The actual number of blows which the low carbon series stood was not affected seriously by wide variations in the silicon content. The higher silicon irons seemed somewhat stiffer.

The series of varying carbon show, at the higher carbons, a great reduction of ductility. The results in this connection were most uniform and seem to give the carbon content an importance which has not been generally recognized.

In recording the above data along with the foundry records showing broken and hard castings, an interesting and unexpected result was observed. The broken work on a line of thin and difficult castings had been running 2.25 per cent, and the lost work around 12 per cent, when making an iron corresponding to the third series given above. As soon as a higher silicon and low carbon mixture was made, both the broken and bad percentages were considerably reduced, the broken averaging 1.50 per cent and the bad 8 per cent. The writer cannot explain why this change should render the castings less liable to breakage, but believes that the higher fluidity was responsible for the reduction in the percentage of lost castings.

Aside from the technical aspects of this question there is an important economic aspect. With pig iron fairly high in silicon, a larger percentage of scrap can be used on high silicon, low carbon mixtures. In a charge initially low in carbon, the silicon seems to have a lesser tendency to burn out. Especially is this fact of value in enabling the use of large quantities of malleable scrap.

In general, we conclude that where extreme ductility is desired the low silicon low carbon mixture is best, but for the average line of work a high silicon low carbon mixture will fulfill every requirement. It seems to reduce scrap and add greatly to the economy and ease of operation of the furnace.

Below are given two typical charges with resulting analyses:

HEAT NO. 223.

	Pounds
Sprue	7,600
Old Mall	1,000
Steel	200
Pig Iron	8,200
	17,000

	Sil.	Sulph.	Mang.	Carb.
Charge Analysis...	1.14	.041	.390	2.76
Hard Iron Analysis	1.08	Not determined.	.210	2.22

HEAT NO. 506.

	Pounds
Sprue	7,500
Old Mall	300
Steel	200
Pig Iron	9,000
	17,000

	Sil.	Sulph.	Mang.	Carb.
Charge Analysis....	1.17	.043	.398	3.02
Hard Iron Analysis	.93	Not determined.	.226	2.60

A further economic consideration is that the higher fluidity of the high silicon low carbon heats means less loss in melting, and shorter heats. This greater fluidity is very pronounced.

Tuyere Area of the Cupola

Question:—We operate a 72-inch cupola, lined to 48 inches, which is equipped with six tuyeres, six inches square at the shell and 6 x 10 inches inside. We are anxious to maintain a blast pressure of seven ounces, but this does not give us hot iron sufficiently fast for our purpose. However, we can obtain hot iron at a pressure of from 9 to 10 ounces. We would like to know whether we should not increase the tuyere area and if so, to what extent, or what change will be necessary to obtain hot iron at a pressure of seven ounces. We are melting eight tons daily with by-product coke at a ratio of 1 to 7, including the bed, and the blast is furnished by a blower, which delivers 37½ cubic feet of air per minute, operating at 140 revolutions.

Answer:—By increasing the area of the tuyere until the inside is nearly continuous, you can use a low pressure, but usually a pressure of 10 to 16 ounces is advisable. You had better consult the manufacturer of your blower and ascertain if you are getting sufficient air to melt as fast as you desire.

Distance of Tuyeres From Sand Bottom

By W. J. Keep

Question:—What is the proper height from the bottom of the tuyeres to the sand bottom of a cupola 34 inches in diameter?

Answer:—The height of the tuyeres from the sand bottom depends upon the requirements of the shop. If the iron is to be tapped as fast as it is melted, the bottom of the tuyeres should be about 12 inches above the sand bottom. In a foundry making machinery castings the cupola generally is designed to hold sufficient iron for the average casting made and the tuyeres frequently are located 3 to 4 feet above the sand bottom. The melting of the iron continues until the molten metal shows at the tuyeres, when it must be tapped. When operating large cupolas, which will melt eight to 10 tons per hour, a ladle of five tons can be filled and carried away while another ladle of the same size is filled with molten metal and then both are used to pour the work. Hand ladles also may be filled to help out. Even if the iron in the first ladle is a trifle dull, the hot iron will cause the metal to fill the mold. With a 34-inch cupola you can melt sufficiently fast to fill a large ladle by charging small scrap and pig iron in small pieces and additional iron melted can be tapped into small bull ladles. In case the iron in the large ladle is too dull to pour, 0.5 per cent of aluminum should be added to the ladle and which, without stirring, will make the iron fluid.

Figuring Weights of Castings

Question:—Referring to Data Sheet No. 153, published in the January, 1914, issue of THE FOUNDRY, I am unable to apply definitely the different weights indicated. Also I would like to know the weight per cubic inch of iron.

Answer:—The weights per cubic inch are not different weights per cubic inch of cast iron, but are those of the various metals or alloys, including iron, of course, that might be used in making a casting. Regardless of what material the casting is made of, its weight per cubic inch can be found in the tables given since they cover the weight of the lightest metal, aluminum, to that of the heaviest, including lead, and from the weight the correct constant to use in the formula for its weight can be found. Since it is desired to use only formulas for iron castings, constants only are required corresponding to the weight per cubic inch of iron, which is 0.260, giving K a value of 0.0681 on Data Sheet No. 153. The constants corresponding to other weights per cubic inch are useful to those who may have occasion to calculate the weights of castings made out of other metals, such as copper or brass.

The car shops and foundry of the Pittsburgh Shawmut & Northern railroad, at St. Mary's, Pa., which were closed when railroad business became slack, are again operating in full, giving employment to 400 men.

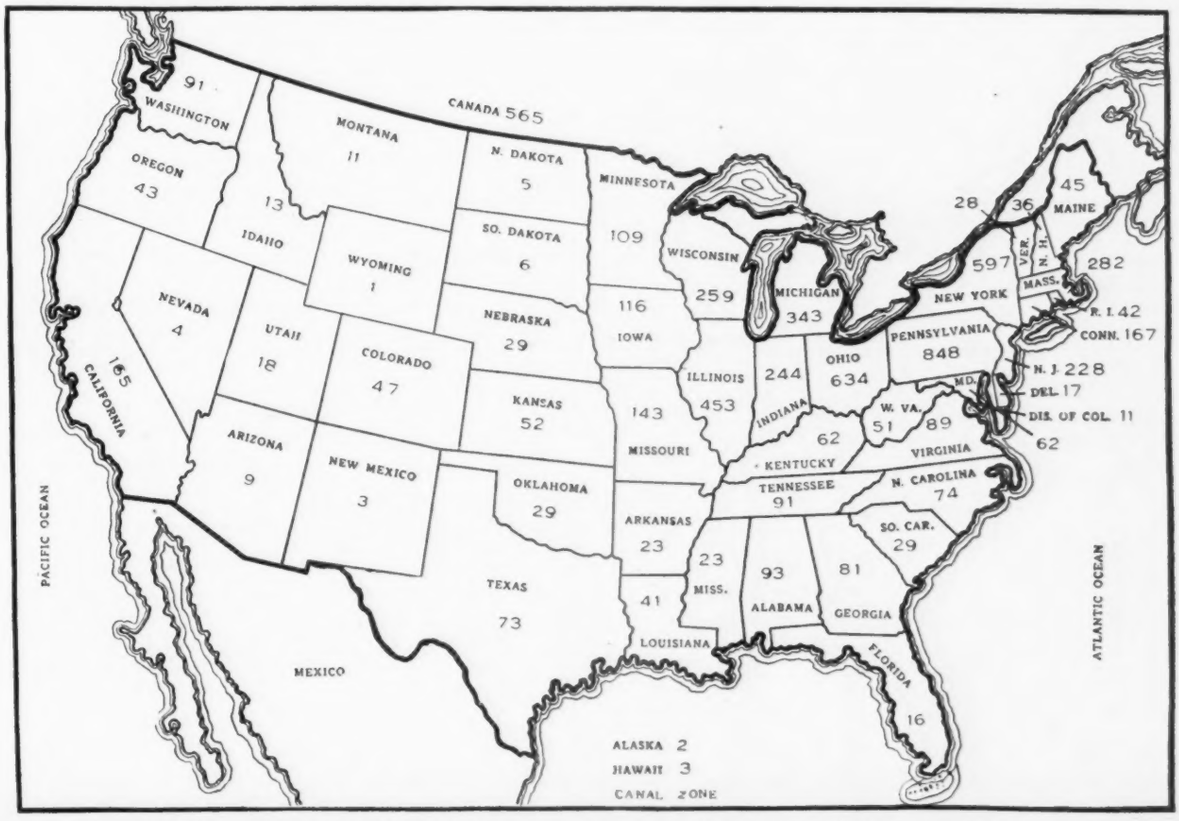
Statistics of the American Foundry Industry

Plants in the United States and Canada Engaged in the Manufacture of Gray Iron, Steel, Malleable and Brass Castings

THAT the foundry trade of the United States and Canada continues to maintain its position in the front rank of the metal-working industries of the North American continent is indicated by the statistics of casting manufacture compiled by THE FOUNDRY. On Sept. 15, a total of 6,507 plants were engaged in the production of gray iron, steel, malleable, brass and aluminum castings in the United States and Canada, as compared with 6,538 on July 1, 1912, a loss of 31 shops. Considering the unsatisfactory trade conditions which have prevailed for a period of practically two years and the tendency toward the establishment of larger manufacturing units, the loss is comparatively small. Although no figures have been compiled on capacity and production, the consumption of foundry grades of pig iron indicate a large increase in the output of gray iron and steel castings during this period. On April 1, 1910, there were 6,594 foundries in the United States and Canada and in 1908 the total number of casting plants aggregated 6,366. Regardless of the trade depression, the foundry industry, based on the large number of plants that passed out of existence in the last two years, must be considered among the precarious trades. Numerous changes in firm names reflect dissatisfaction with the management, and it is estimated that fully 25 per cent of the companies that were listed in 1912 do not appear among the operating plants in 1914. To the lack of proper accounting systems the large number of failures among foundrymen must be attributed. Competition only, in too many instances, is the controlling factor of the fixing of selling prices, and that the quotations invariably are too low is indicated by the large number of failures recorded. While there are numerous unknown quantities in estimating selling prices, such as cost of molding, coremaking, etc., nevertheless, with a proper allowance for contingencies, and with a known overhead, the losses incurred would be greatly reduced and the cost of castings would be increased automatically. Unfortunately the demand for tonnage and the desire to close every order in sight, regardless of price, is the spirit which moves the majority of foundrymen, and the resulting competition reduces prices to a basis that must result in heavy losses.

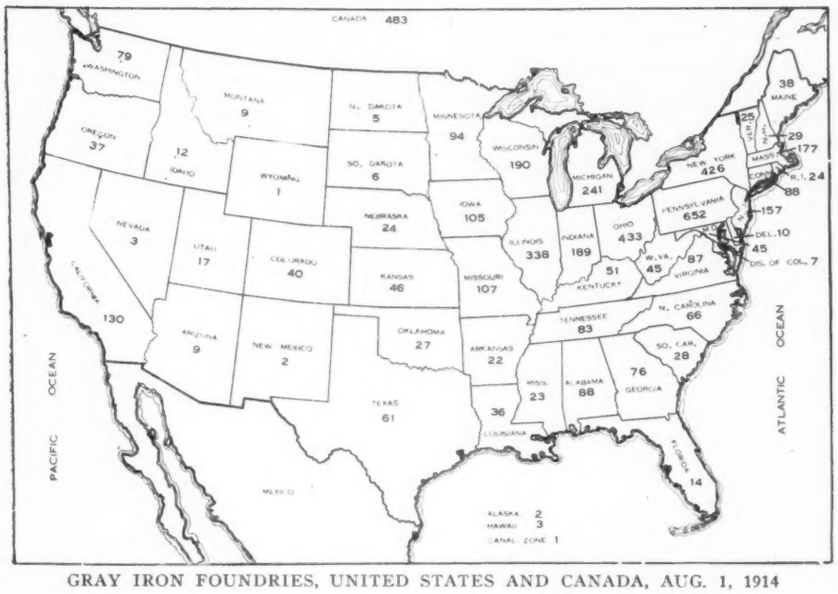
During the past two years many shops have greatly increased their capacity and the number of new plants built is in excess of 500. In 1906, 6,108 casting plants were in operation in the United States and Canada, but the decline in the number of individual firms dates from 1910, inasmuch as during the preceding four years there was a steady increase in the number of shops.

In the compilation of these statistics, each plant was considered as a unit, regardless of the number of casting departments it contains. All of the side-blow converter plants operate gray iron departments, as the iron first is melted in the cupola before it is charged into the converters. Also, practically all of the malleable shops melt gray iron for making annealing boxes, and the brass department of gray iron, steel and malleable shops far exceed the foundries that melt brass, bronze and alum-

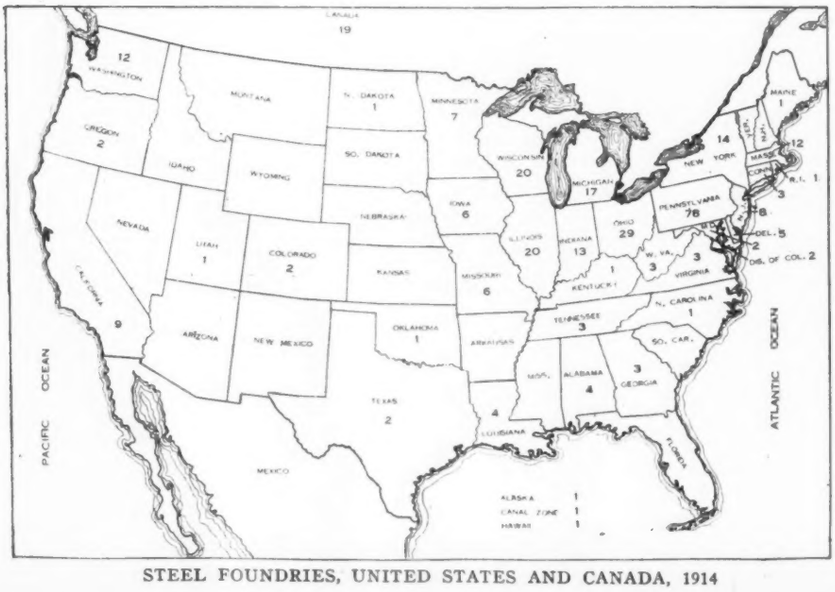


TOTAL NUMBER OF FOUNDRIES IN THE UNITED STATES AND CANADA, SEPT. 15, 1914.

TOTAL FOUNDRIES IN THE UNITED STATES AND CANADA, 1912



GRAY IRON FOUNDRIES, UNITED STATES AND CANADA, AUG. 1, 1914



STEEL FOUNDRIES, UNITED STATES AND CANADA, 1914

inum exclusively. Considering each department as a unit, there were 9,421 casting plants in the United States and Canada on Aug. 1, 1914, as compared with 9,158 in 1912, a gain of 263. In 1910 the number of casting units, figured on the foregoing basis, was 9,158.

A comparison of the total foundries in the United States and Canada in 1914 and 1912, is made in Table I. On Aug. 1, this year, the total foundries in the United States was 5,942, against 5,996 in 1912, a loss of 54. Canada had a total of 565 casting plants, as compared with 542 in 1912, a gain of 23. This increase is due to the unparalleled industrial prosperity enjoyed by the Canadian Provinces in recent years, and in the northwest, many new shops have been established to meet the growing

Table I.

TOTAL FOUNDRIES IN THE UNITED STATES AND CANADA, 1914 AND 1912	
United States and Canada, 1914....	6,507
United States and Canada, 1912....	6,538
Total foundries, loss.....	31
Foundries in U. S., 1914.....	5,942
Foundries in U. S., 1912.....	5,996
Loss in U. S.....	54
Foundries, Canada, 1914.....	565
Foundries, Canada, 1912.....	542
Increase in Canada.....	23
GRAY IRON FOUNDRIES IN THE UNITED STATES AND CANADA, 1914 AND 1912	
United States and Canada, 1914....	5,057
United States and Canada, 1912....	4,943
Total gray iron increase.....	114
Gray iron, U. S., 1914.....	4,574
Gray iron, U. S., 1912.....	4,475
Increase in U. S.....	99
Gray iron, Canada, 1914.....	483
Gray iron, Canada, 1912.....	468
Increase in Canada.....	15
MALLEABLE FOUNDRIES IN THE UNITED STATES AND CANADA, 1914 AND 1912	
United States and Canada, 1914....	214
United States and Canada, 1912....	190
Increase	24
United States, 1914.....	196
United States, 1912.....	175
Increase	21
Canada, 1914	18
Canada, 1912	15
Increase	3
STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, 1914 AND 1912	
United States and Canada, 1914....	318
United States and Canada, 1912....	318
United States, 1914.....	299
United States, 1912.....	299
Canada, 1914	19
Canada, 1912	19

requirements of this rapidly growing territory.

In spite of the increasing production of steel castings, and the replacement of gray iron section with cast steel, an increase of 114 gray iron shops was recorded in the United States and Canada in two years. From 1910 to 1912, there was a loss of 214; the gain since 1912, also is reflected by the large increase in the consumption of foundry grades of pig iron. The total gray iron foundries in the United States is 5,057, as compared with 4,943 in 1912 and 5,157 in 1910. The United States has 4,574 gray iron shops, against 4,475 in 1912, a gain

Table II.

TOTAL OF EXCLUSIVE BRASS FOUNDRIES AND BRASS DEPARTMENTS OF OTHER PLANTS IN THE UNITED STATES AND CANADA, 1914 AND 1912

United States and Canada, 1914....	3,832
United States and Canada, 1912....	3,680
Increase	152
Total brass, U. S., 1914.....	3,498
Total brass, U. S., 1912.....	3,389
Increase	109
Total brass, Canada, 1914.....	334
Total brass, Canada, 1912.....	291
Increase	43

EXCLUSIVE BRASS FOUNDRIES IN THE UNITED STATES AND CANADA, 1914 AND 1912

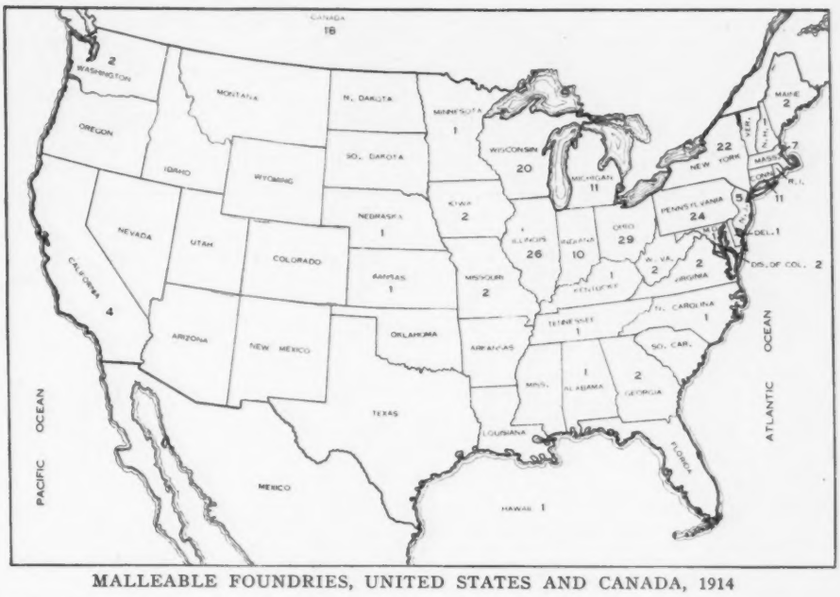
United States and Canada, 1914....	1,266
United States and Canada, 1912....	1,258
Increase	8
Exclusive brass, U. S., 1914.....	1,202
Exclusive brass, U. S., 1912.....	1,197
Increase	5
Exclusive brass, Canada, 1914.....	64
Exclusive brass, Canada, 1912.....	61
Increase	3

BRASS DEPARTMENTS OF GRAY IRON, MALLEABLE AND STEEL FOUNDRIES IN THE UNITED STATES AND CANADA, 1914 AND 1912

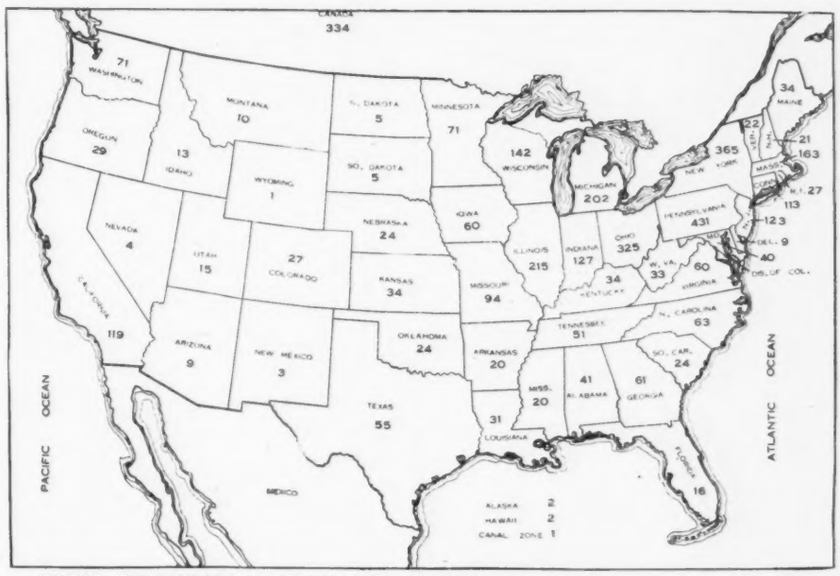
United States and Canada, 1914....	2,566
United States and Canada, 1912....	2,408
Increase	158
Brass depts., U. S., 1914.....	2,296
Brass depts., U. S., 1912.....	2,178
Increase	118
Brass depts., Canada, 1914.....	270
Brass depts., Canada, 1912.....	230
Increase	40

FOUNDRIES MELTING ALUMINUM IN THE UNITED STATES AND CANADA, 1914 AND 1912

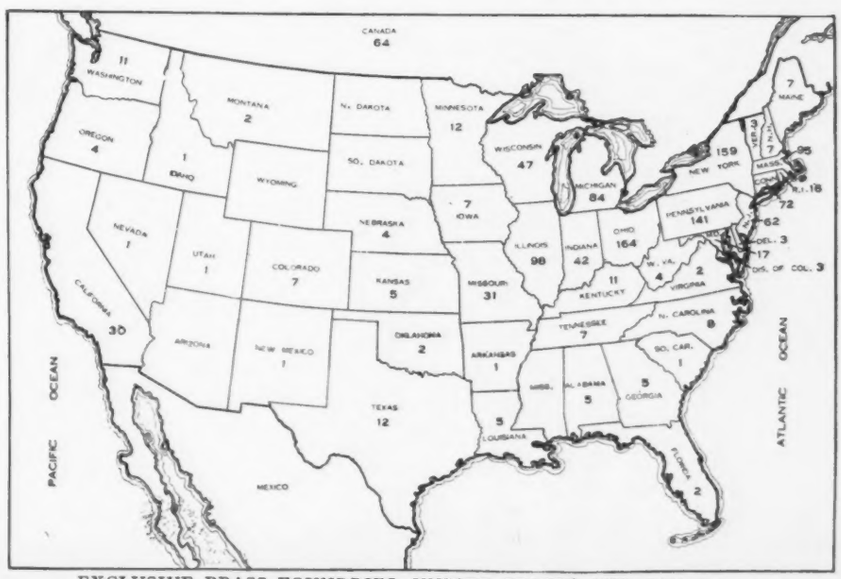
United States and Canada, 1914....	2,026
United States and Canada, 1912....	2,019
Increase	7
United States, 1914.....	1,850
United States, 1912.....	1,881
Loss	31
Canada, 1914	176
Canada, 1912	138
Increase	38



MALLEABLE FOUNDRIES, UNITED STATES AND CANADA, 1914



TOTAL FOUNDRIES MELTING BRASS, UNITED STATES AND CANADA, 1914



EXCLUSIVE BRASS FOUNDRIES, UNITED STATES AND CANADA, 1914

of 99, and Canada has 483, as compared with 468 in 1912, an increase of 15.

That the malleable iron industry is growing steadily, is indicated by an increase in the number of shops in the United States and Canada of 24, from from 175 in 1912, to 196 in 1914, a gain of 21. Canada makes malleable iron in 18 shops as compared with 15 two years ago, an increase of 3. The melting capacity of many of the malleable plants also have been greatly expanded by the installation of additional furnaces, and while steel castings are making inroads in the malleable field, these figures indicate that the demand from other sources is sufficient to insure the industry a normal growth. Ohio continues to lead as a malleable iron producer with 29 shops, as compared with 27 two years ago. Illinois is second with 26, Pennsylvania third with 24 and New York fourth with 22. In Canada, the Province of Ontario leads with a total of 13. Illinois has replaced Pennsylvania as the second state, the number of shops having been increased from 22 to 26, whereas Pennsylvania lost two. Wisconsin remained stationary with 20 and Michigan shows an increase from 8 to 11.

Table III.

FOUNDRIES IN THE UNITED STATES AND CANADA BY STATES AND PROVINCES, 1914 AND 1912.

	Total foundries, 1914.	Total foundries, 1912.	Increase or decrease in two years.	Gray iron foundries, 1914.	Gray iron foundries, 1912.	Exclusive brass foundries, 1914.	Exclusive brass foundries, 1912.	Brass foundries departments of other shops, 1914.	Total brass foundries, 1914.	Malleable iron foundries, 1914.	Steel foundries, 1914.	Foundries melting aluminum, 1914.
UNITED STATES:—												
Alabama	93	99	— 6	88	94	5	5	36	41	1	4	19
Alaska	2	2	....	2	2	...	...	2	2	...	1	1
Arizona	9	9	....	9	9	...	...	9	9	...	...	6
Arkansas	23	28	— 5	22	25	1	3	19	20	...	...	10
California	165	150	+15	130	127	30	25	89	119	4	9	86
Canal Zone	1	1	....	1	1	...	...	1	1	...	1	...
Colorado	47	52	— 5	40	44	7	8	20	27	...	2	16
Connecticut	167	170	— 3	88	87	72	73	41	113	11	3	62
Delaware	17	19	— 2	10	11	3	4	6	9	1	5	3
Dist. of Columbia	11	13	— 2	7	7	3	5	4	7	2	2	5
Florida	16	16	....	14	14	2	2	14	16	...	...	11
Georgia	81	85	— 4	76	79	5	6	56	61	2	3	29
Hawaii	3	4	— 1	3	3	...	1	2	2	1	1	1
Idaho	13	10	+ 3	12	9	1	1	12	13	...	...	7
Illinois	453	450	+ 3	338	335	98	97	117	215	26	20	149
Indiana	244	259	—15	189	102	42	48	85	127	10	13	74
Iowa	116	130	—14	105	117	7	11	53	60	2	6	42
Kansas	52	57	— 5	46	51	5	6	29	34	1	...	29
Kentucky	62	63	— 1	51	54	11	9	23	34	1	1	21
Louisiana	41	45	— 4	36	41	5	4	26	31	...	4	9
Maine	45	49	— 4	38	41	7	8	27	34	2	1	17
Maryland	62	64	— 2	45	50	17	13	23	40	1	2	22
Massachusetts	282	277	+ 5	177	174	95	94	68	163	7	12	111
Michigan	343	340	+ 3	241	246	84	86	118	202	11	17	134
Minnesota	109	114	— 5	94	96	12	15	59	71	1	7	46
Mississippi	23	26	— 3	23	26	...	...	20	20	...	...	8
Missouri	143	145	— 2	107	110	31	30	63	94	2	6	61
Montana	11	11	....	9	9	2	2	8	10	...	...	6
Nebraska	29	29	....	24	25	4	3	20	24	1	...	21
Nevada	4	2	+ 2	3	2	1	...	3	4	...	...	3
New Hampshire	36	37	— 1	29	30	7	7	14	21	1	...	14
New Jersey	228	240	—12	157	160	62	69	61	123	5	8	68
New Mexico	3	3	....	2	2	1	1	2	3	...	...	1
New York	597	631	—34	426	434	159	176	206	365	22	14	225
North Carolina	74	71	+ 3	66	66	8	5	55	63	1	1	34
North Dakota	5	5	....	5	5	...	...	5	5	...	1	3
Ohio	634	618	+16	433	432	164	146	161	325	29	29	196
Oklahoma	29	27	+ 2	27	25	2	2	22	24	...	1	14
Oregon	43	42	+ 1	37	38	4	2	25	29	...	2	19
Pennsylvania	848	841	+ 7	652	652	141	137	290	431	24	78	265
Rhode Island	42	40	+ 2	24	25	16	14	11	27	...	1	16
South Carolina	29	31	— 2	28	30	1	1	23	24	...	...	14
South Dakota	6	6	....	6	6	...	...	5	5	...	...	3
Tennessee	91	95	— 4	83	84	7	10	44	51	1	3	34
Texas	73	78	— 5	61	65	12	13	43	55	...	2	30
Utah	18	19	— 1	17	18	1	1	14	15	...	1	12
Vermont	28	28	....	25	25	3	3	19	22	...	...	11
Virginia	89	87	+ 2	87	86	2	1	58	60	2	3	34
Washington	91	80	+11	79	69	11	9	60	71	2	12	47
West Virginia	51	51	....	45	46	4	4	29	33	2	3	13
Wisconsin	259	246	+13	190	185	47	37	95	142	20	20	87
Wyoming	1	1	....	1	1	...	...	1	1	...	...	1
Total in United States	5,942	5,996	*—54	4,574	4,475	1,202	1,197	2,296	3,498	196	299	1,850
CANADA:—												
Alberta	13	4	+ 9	10	4	3	...	10	13	...	1	8
British Columbia	21	19	+ 2	19	18	2	1	17	19	...	1	9
Manitoba	14	12	+ 2	12	10	2	2	6	8	...	...	6
New Brunswick	23	24	— 1	19	20	4	4	15	19	...	...	6
Newfoundland	2	2	....	1	1	1	1	...	1	...	...	...
Nova Scotia	33	37	— 4	31	32	1	4	20	21	1	2	8
Ontario	341	330	+11	286	248	40	37	143	183	13	7	102
Prince Edward Island	3	4	— 1	3	4	...	...	3	3	...	...	1
Quebec	109	108	+ 1	97	94	11	12	50	61	4	7	33
Saskatchewan	5	1	+ 4	5	1	...	...	5	5	...	...	3
St. Pierre Et. Miquelon	1	1	....	...	...	...	...	1	1	...	1	...
Total in Canada	565	542	†+23	483	468	64	61	270	334	18	19	176
Total in United States and Canada	6,507	6,538	*—31	5,057	4,943	1,266	1,258	2,566	3,832	214	318	2,026

*Net decrease.
†Net increase.

The most remarkable feature of these statistics is the fact that the number of steel casting plants in the United States and Canada remained unchanged over a period of two years. The number of new shops equalled those dismantled, and this is true of the totals in the United States as well as those of Canada. The total number of steel foundries is 318, of which the United States has 299 and Canada, 19. In 1910 there were 265 steel casting plants in the United States and Canada, of which the former had 248 and the latter, 17. Pennsylvania leads with 78. Ohio follows with 29, against 34 two years ago; Illinois has 20 as compared with 24 in 1912, and Wisconsin has 20, a loss of two in two years.

No other branch of the foundry industry shows a growth comparable with that of the brass casting trade. In large measure this is attributed to the expansion of the automobile and motor truck industries, and in the leading motor car manufacturing centers the increase in the number of brass foundries is most pronounced. The total number of plants melting non-ferrous metals in the United States and Canada is 3,832 as compared with 3,680 two years ago, a gain of 152. In 1910 the total brass shops was 3,558 and the increase in four years is 274. The total brass shops in the United States is 3,498 as compared with 3,389 two years ago, a gain of 109. Canada has 334 brass foundries, against 291 in 1912, an increase of 43. On the other hand, there has been a gain of only 8 in the number of exclusive brass foundries in the United States and Canada since 1912. The total number of plants of this kind in the two countries is 1,266, against 1,258 in 1912. The United States has 1,202 and Canada, 64, the former showing an increase of five and the latter, three. Gray iron, steel and malleable foundries operated 2,566 non-ferrous metal departments on Aug. 1, 1914, in the United States and Canada, an increase of 144 in a period of two years. In compiling the statistics of the non-ferrous melting industry, care was exercised to secure accurate information regarding plants that produced non-ferrous castings exclusively, and those operated as departments of gray iron, steel and malleable plants.

Aluminum Foundries

Aluminum is being melted in 2,026 foundries in the United States and Canada, as compared with 2,019 in 1912, a gain of seven. Canada shows an increase of 38, from 138 in 1912, to 176, this year. On the other hand, the United States shows a loss of 31, the number of plants having declined from 1,881 in 1912 to 1,850 this year. The rapid growth of this white metal casting industry has been phenomenal since 1910, when only 1,679 foundries reported that they were equipped to cast aluminum.

The accompanying charts graphically show the distribution of the casting plants throughout the United States and Canada, and Table III gives the total number of foundries by states and provinces. Pennsylvania leads in number of foundries by a wide margin, with a total of 848, having gained seven in a period of two years. Ohio ranks second with 634, and the gain in a period of two years is the largest of any of the states, aggregating 18. New York ranks third with 597, but suffered the largest loss of all of the states, the decline in number of shops being 34 in two years. The other leading states rank in the following order, and the gains and losses since 1912 also are indicated: Illinois, 453, gain, 3; Michigan, 343, gain, 3; Massachusetts, 282, gain, 5; Wisconsin, 259, gain, 13; Indiana, 244, loss 15; New Jersey, 228, loss, 12; Connecticut, 167, loss 3, and California, 165, gain, 15. In Canada the Province of Ontario leads with 341 and Quebec is second with 109. The largest increase in number of foundries, however, is shown by Alberta, which now has 13 casting shops as compared with four two years ago, a gain of 9.

Chicago continues to rank first among the leading foundry centers of the United States and Canada, with Philadelphia second, New York third and Cleveland fourth. Pittsburgh, which has been replaced by Cleveland, now ranks seventh. This is due to the fact that many shops in the business district of that city have located in outlying towns and the production of castings in the so-called Pittsburgh district is much larger than it was two years ago. Chicago has 170 shops, as compared with 169, two years ago, a gain of one. Philadelphia has 121, having gained two in two years, while New York City with 116 has lost 12 since 1912. Cleveland with 104, shows the largest increase of any of the cities. In 1912 the total number of plants was 91 and the gain in two years was 13. Detroit ranks fifth, with 99; Milwaukee sixth, with 71; Pittsburgh seventh, with 70; Buffalo eighth, with 67; St. Louis ninth, with 64 and Cincinnati tenth, with 63. Toronto is the leading center of Canada, with a total of 48 shops, against 44 in 1912, a gain of four.

Table IV.

LEADING FOUNDRY CENTERS OF THE UNITED STATES AND CANADA

	Total foundries 1914.	Total foundries 1912.
Chicago	170	169
Philadelphia	121	119
New York City	116	128
Cleveland	104	91
Detroit	99	98
Milwaukee	71	69
Pittsburgh	70	109
Buffalo	67	66
St. Louis	64	63
Cincinnati	63	74
Boston	53	49
Toronto, Ont.	48	44
Newark	43	54
Baltimore	39	37
San Francisco	38	38
Minneapolis	35	39
Indianapolis	34	32
Louisville	31	30
Erie	30	29
Montreal	28	29
Chattanooga	28	27
Dayton	28	27
Rochester	28	27
Birmingham	26	31
Toledo	26	25
Reading	25	24
Jersey City	23	22
Bridgeport, Conn.	23	22
Kansas City	22	25
Worcester, Mass.	22	21
Providence, R. I.	21	19
Seattle	21	19
Atlanta	20	23
Portland, Ore.	19	18
Hamilton, Ont.	18	17
Racine, Wis.	17	18
New Haven	15	16

Personal

G. W. Haydon recently resigned his position as general superintendent of the Gould Coupler Co., Depew, N. Y.

John R. Metcalf has been made treasurer of the Erie Malleable Iron Co., Erie, Pa.

J. M. Morton manager of the foundry department of the George F. Shevlin Mfg. Co., Saratoga Springs, N. Y., has resigned.

W. Scott Matheson, for eight years estimator and sales manager of the Seattle Construction and Dry Dock Co., Seattle, Wash., has resigned to accept the position of manager of the Westerman Iron Works.

To Represent New Lines Abroad

The J. W. Jackman Co., Ltd., Manchester, Eng., is desirous of communicating with manufacturers of foundry equipment, particularly makers of new lines that have been introduced recently. Catalogs of new foundry tools are desired with a view of representing American manufacturers in Europe. The Jackman company is a large dealer in foundry equipment both in England and on the continent and represents a number of American manufacturers.

The Portsmouth, Eng., meeting of the Institute of Metals, which was scheduled for Sept. 10 and 11 was indefinitely postponed on account of the European war. A number of interesting papers were to have been presented at this meeting, and which, however, already have been printed and sent to the members.

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Trade Outlook

TRADE conditions generally continue unsettled, although a marked improvement in the financial situation is reported, and it is believed that many projects, action upon which was deferred by the European war, now will be undertaken and suspension orders will be withdrawn. The readjustment of business in this country to the unparalleled conditions now prevailing, has been rapid and the easing of finances will be productive of an increased volume of orders. The buying of pig iron is limited to lots for immediate requirements only, although quotations are exceedingly attractive from the user's standpoint. Prices in leading centers follow: No. 2, Pittsburgh, $13.90; Cleveland, $13.75; Chicago, $13.50; Buffalo, $13, and Birmingham, $10. Basic is quoted at $13.90, Pittsburgh, and $14, eastern Pennsylvania, while malleable is quiet at $13.25, Chicago, and $13, Buffalo.

What the Convention Taught

A TENDENCY toward crowded programs has been manifested at recent meetings of various technical societies and the late conventions of the American Foundrymen's Association and the Institute of Metals would have been more interesting and more valuable if some of the routine could have been eliminated. While it is evident that a long list of papers is a potent factor in increasing the attendance, nevertheless some opportunity should be afforded for discussion, but unfortunately this cannot be allowed when the presentation of papers alone occupies the entire period allotted to one session. The presentation of papers in abstract is a step in the right direction, as the reading of complete manuscript, regardless of its compelling interest, soon tires the auditors and a lack of attention immediately is noticeable. The work of every technical society should be directed in certain, prescribed channels, and this can best be accomplished by committee work. A small body of men, investigating one subject, can accomplish wonderful results, and this is best reflected by the report of the committee on steel foundry standards, which thoroughly examined into the nozzle problem and its findings will prove helpful, not only to steel foundrymen, but also to the manufacturers of these refractories. The American Foundrymen's Association is to be congratulated upon its appointment of a large number of committees of excellent personnel, and it is certain that these reports will add greatly to the value and interest of the next convention. Unfortunately, no time was available to discuss the large number of valuable papers and reports present at the "Cost Congress". The interest manifested in this session was reflected by the large attendance, and this feature should again find a place on the association program. The symposium of papers on malleable, steel and gray iron attracted a large attendance of those interested in these branches of foundry work and many manufacturers arranged their convention visit to enable them to be present at the session in which they were most vitally interested. A restricted program of papers, more committee reports and a limitation of sessions to a period of two hours will add materially to the value of meetings of all technical societies.

A New Machine for Making Cores in Multiple

The Sequence of Operations Are Clearly Shown, But the Work is Accomplished in One-and-One-Half Minutes—New Sand Blast Barrel

AN exceedingly novel and ingenious type of machine for making large quantities of cores in multiple has been designed and is being manufactured by the Wadsworth Core Machine & Equipment Co., Akron, O. The machine shown in the acompanying illustrations originally was built for making ¼-inch round cores 16 inches long and had a capacity for producing 48 cores, vented from end to end, in 1¼ minutes. It next was equipped for making 36 ¼-inch cross cores, and they were produced in 1½ minutes, ready for baking. The manufacturer states that if he were again fitting up for this work, instead of having six rows each way in the core box, he would have eight rows, a total of 64 cavities, thereby producing 64 in place of 36 cores in a period of 1½ minutes.

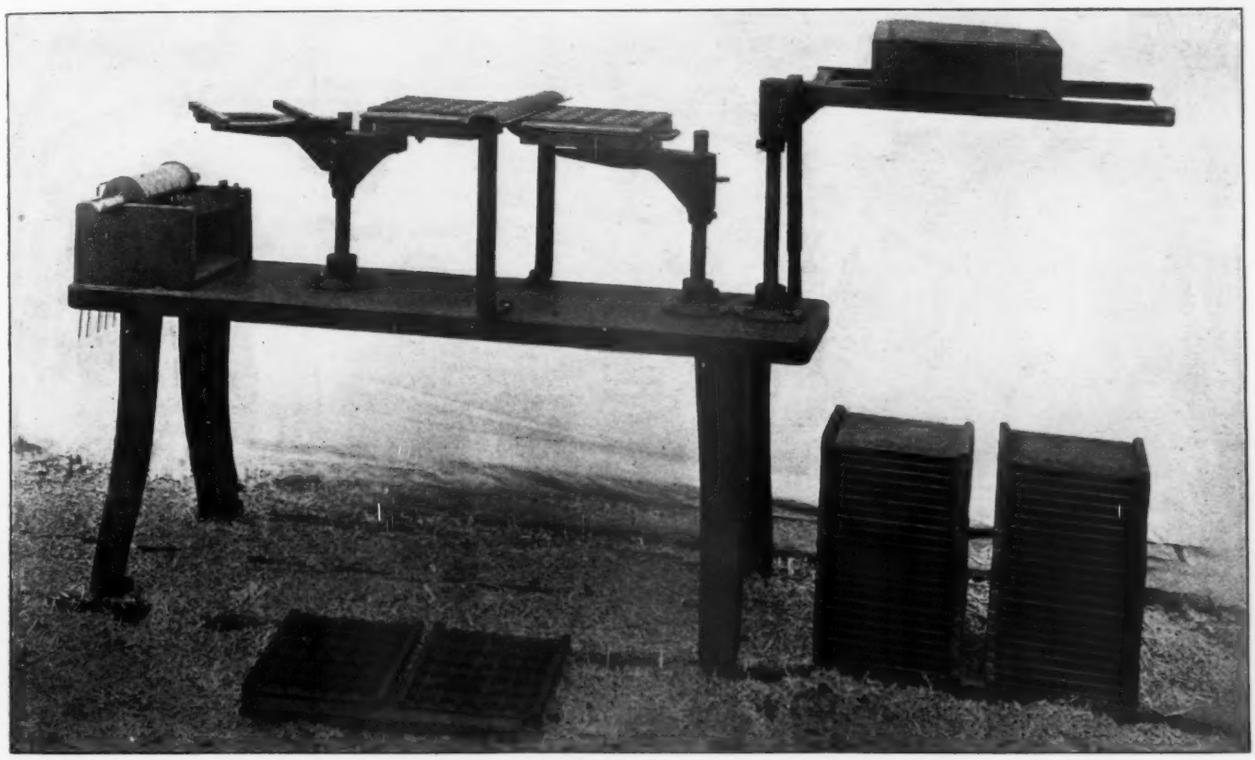


FIG. 1—MACHINE FOR MAKING MULTIPLE CORES

As illustrated in Fig. 1, the machine is mounted on a cast iron table, supported by four cast iron legs. The sand riddle is shown at the right on a swinging frame, the core box is in the center and at the left are shown the scrapers, together with the venting roll. In the foreground two plates of baked cores are illustrated and on the ground at the right are the core trays.

The first operation consists of shaking parting compound onto the face of the core box and the next operation, Fig. 2, consists of throwing sand into the swinging riddle over the top of the core box. After the sand is placed in the riddle it is shaken backwards and forwards on top of the frame, thereby riddling the sand in an even amount on top of the core box. The riddle and frame then are swung out of the way for the succeeding operation. Fig. 3 shows the sand riddled on the face of the core box with the sand riddle swung aside. In Fig. 4 the operator has swept off the surplus sand and is ready for rolling down the cores and vents. The method of rolling down the cores into the cavities and simultaneously venting them is shown in Fig. 5. Next the surplus sand is scraped off the face of the core box and the roll again is run across the top of the core face, rolling down the sand after scraping. The surplus sand between the cores then is blown off, either with an air hose or with bellows, after which the operator brings the two halves of the core box together to produce the completed core. This operation is illustrated in Fig. 6. In Fig. 7 the core box is supported by the rest at the left and one-half of the box is being jarred with a rawhide mallet. The operator then swings the core box over to the right hand rest to jar the other half with the mallet. In Fig. 8 the top half of the core box has been rolled over and dropped down and the rest has been swung around to receive the core tray, which is higher than the rest for the core box. In Fig. 9 the core receiving tray has been placed on top of the last half of the core box, clamped and is ready for the final rolling-over operation. After rolling over and unclamping, the tray with the cores is supported on the rest at the left, and in Fig. 10 the coremaking operation has been completed. This entire operation is performed in 1½ minutes.

The machine is particularly adapted for making multiple cores for brass, malleable, gray iron or steel castings

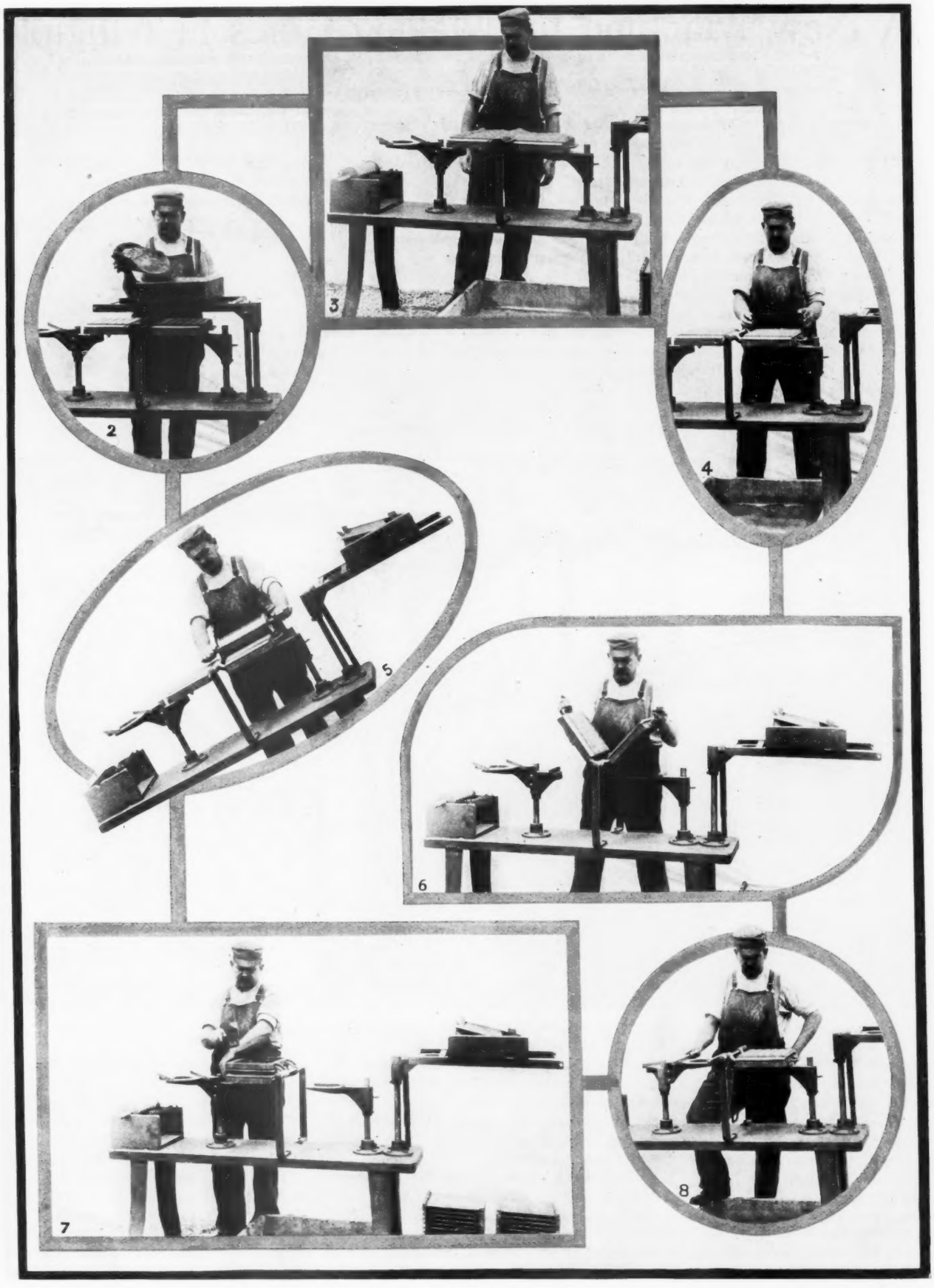


FIG. 2—PLACING THE SAND IN THE RIDDLE FIG. 3—SAND RIDDLED ON CORE BOX FIG. 4—SURPLUS SAND SWEPT OFF
FIG. 5—ROLLING CORES INTO THE CAVITIES AND VENTING FIG. 6—CLOSING CORE BOX
FIG. 7—JARRING ONE-HALF OF CORE BOX FIG. 8—TOP HALF OF CORE BOX ROLLED OVER

FIG. 9—CORE TRAY CLAMPED ON TOP HALF OF CORE BOX

and also can be used for making standard round cores to exact length, coned on one or both ends. The quantity produced largely would be governed by the number of cavities in the box and the size and length of the cores required.

"Modern Foundry Appliances and Cleaning Room Equipment" is the title of an exhaustive catalog issued by the Central Iron Works, Quincy, Ill. It contains sixty-four 8½ x 11-inch pages and includes illustrations and descriptions of foundry tumbling mills and their component parts, power transmitting machinery, including shafting pillow blocks, shaft hangers, etc., dust collectors and arresters, sand blast equipment, air compressors, etc. A number of typical cleaning room lay-outs add interest to the work.

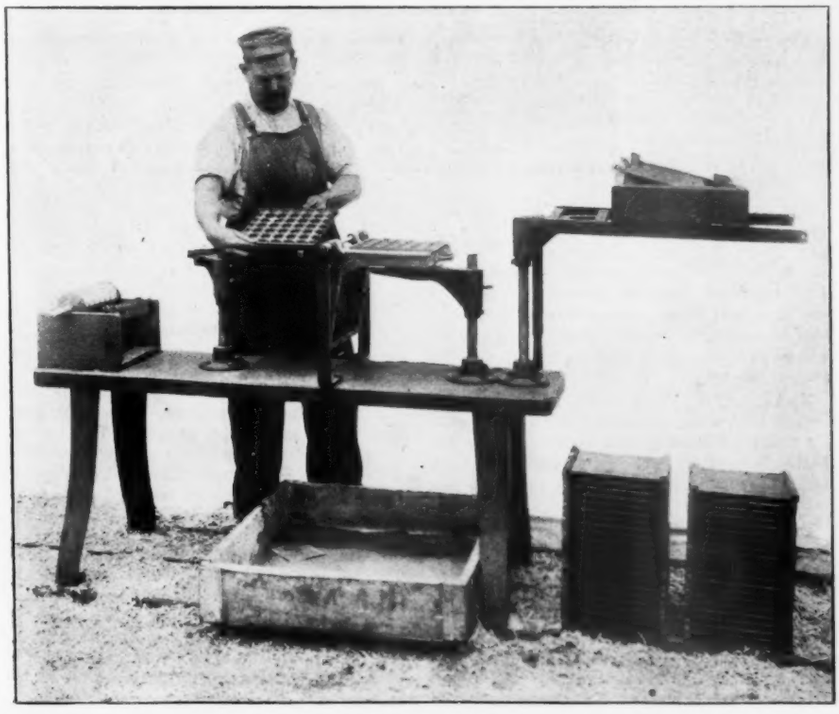
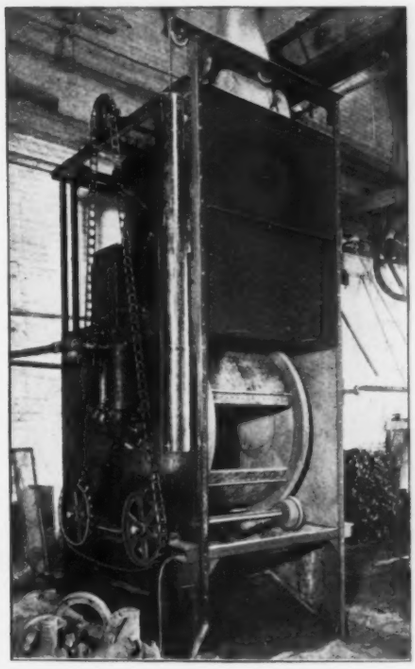


FIG. 10—CORES ON TRAY READY FOR BAKING

Sand Blast Barrel

The American Sand Blast & Machinery Co., Chicago, is marketing an interesting revolving sand blast barrel. It is built in several sizes, the one shown in the accompanying illustration being 15 inches in diameter and 40 inches in length. The barrel is provided with stationary head plates through which the nozzles are thrust. The nozzles are placed well below the axis of the barrel, thus brniging the blast very close to the work to be cleaned. This tends in increase the efficiency of the blast. The housing is built of heavy, riveted steel angles, braced with gusset plates. The frame is covered with No. 12 gage steel plates which are riveted in place.

The barrel is equipped with an elevator, dust separator, water separators,



REVOLVING SAND BLAST BARREL

sand screens and hoppers, mixing sleeves, tight and loose pulleys, etc. It is also provided with a reversing plate located under the barrel, by means of which clean work can be dumped in front of the machine, thus facilitating reloading.

The sand feed is by gravity. A pressure tank, therefore, is unnecessary. The nozzles, it is said, are so designed that the quantity of air used does not vary as the nozzles wear. The machines are built to fit a wide range of air pressures extending from 5 to 150 pounds per square inch.

The machine is free from manifolds and the interior of the barrel is unobstructed. This makes it easy to clean castings or other articles of irregular shape without risk of in-

jury. A machine installed at the plant of the Michigan Malleable Iron Co., Detroit, is said to be cleaning from 12 to 15 tons of malleable castings per 10-hour day. The American Sand Blast & Machinery Co. also manufactures rotary table sand blast machines, machines for sand cleaning carbon steel and high speed steel drills, reamers, etc., table machines for matte finishing, sand blast rooms and pressure tanks.

General Industrial Notes

The foundry of Andrew N. Petersen, Williamsburg, N. Y., was badly damaged by fire.

The Athol Pump Co., Athol, Mass., will erect an addition to its plant at once.

A foundry and forge building will be constructed for the high school at Alameda, Cal.

Cyrus Currier & Son, Newark, N. J., will erect a 50 x 110-foot, one and two-story brick addition to its machine shop, to cost $12,000.

The Findeisen & Kropp Mfg. Co., Twenty-first and Rockwell streets, Chicago, has a permit for a $5,000, one-story, brick foundry.

The Dennison Foundry & Machine Co., Dennison, O., has increased its capital stock from $15,000 to $40,000.

The Empire foundry building, Marysville, Cal., was badly damaged by fire. The machine shop was saved.

The Lattimer Stove Works, Columbus, O., will rebuild its factory. The cost of the new building will be $1,500.

The Knox Stove Works, Knoxville, Tenn., will equip a department for the manufacture of nickel plated parts for stoves.

The Central Foundry Co., Newark, N. J., has been incorporated; $10,000; by Waddill Catchings, R. B. Crispell, H. H. Sykes and others, New York.

The Cleveland Aluminum Casting Co., Cleveland, has been incorporated; $10,000; by J. W. Lovell, G. F. Newton, H. O. Yoder, Jane Scott and N. G. Scherer.

The Buffalo Meter Co., Terrace and Genesee street, Buffalo is having plans prepared for the erection of a factory at Main street and the Erie railroad.

The Geneva Foundry & Machine Co., Aurora, Ill., will erect an office building this fall or next spring on the two lots which it recently purchased.

The Dunham Co., Berea, O., manufacturer of lawn rollers and machinery, will replace its foundry recently destroyed by fire with a fireproof structure.

According to a report of the Business Men's Association, of Hopskinsville, Ky., a foundry will be established at that place by Indiana interests.

The pattern shops of the Kerr Engine Co., Walkerville, Ont., were damaged by fire to the extent of $7,000. The loss was covered by insurance.

The Eagle Scale & Mfg. Co., Harrisonville, Mo., has changed its name to the American Scale Co. and will move its plant to Kansas City and enlarge it.

Fire caused a loss of about $2,500 to Marshall's gray iron foundry, Windsor, Ont.; the loss was confined mostly to machinery and patterns.

The International Foundry Co., Syracuse, N. Y., has been incorporated to manufacture brake shoes and car appliances; $300,000; by F. E. Ehrgood, W. A. Stockel and W. S. Cummings.

The Hunt-Spiller Mfg. Corporation, Boston, has placed a contract with the C. A. Dodge Co., Cambridge, Mass., for the erection of a steel and concrete 50 x 100-foot core room building.

A company to manufacture auto cooking outfits and kitchen cabinets, to be capitalized at $50,000, is being organized at Racine, Wis., by John Dean and G. M. Prentiss. The new concern will occupy the foundry building formerly used by the Reliance Engine Co.

The American Malleables Co., Lancaster, N. Y., will expend between $30,000 and $40,000 on enlarging its plants and rebuilding some of its furnaces. The new buildings to be erected include a pattern shop of brick and steel construction, 50 x 60 feet.

The Jungel Veneer Press Co., Chicago, has been incorporated to manufacture castings, implements, tools, etc.; $1,200; by George A. Schreider, 1027 New York Life building, Chicago; Michael Jungel and Frederick K. Gustin.

The McKinley Tractor Co., maker of gasoline plows, will locate in Belleville, Mo., where, a 10-acre site has been donated and over $25,000 has been subscribed by local capitalists.

The Maxwell Implement Co., Valparaiso, Ind., has been incorporated to manufacture farm implements; $40,000; by Charles W. Benton, George L. Maxwell and S. Bert Hodsdon.

The Modern Auto Parts Co., Chicago, has been incorporated to manufacture automobile parts, gasoline engines and parts; $20,000; by W. R. Fetzer, E. A. Biggs and E. S. Carr, 69 West Washington street.

The plant of the O. K. Stove & Range Co., Louisville, Ky., which was recently damaged by fire is being rebuilt. The cupola house suffered the greatest loss and the company will erect a new cupola.

The Pan-American Brake Co., New York City, has been incorporated to operate a foundry and pattern shop; $10,000; by R. W. Marshall, L. G. Nilson, J. A. Noble, 469 Eastern Parkway, Brooklyn.

NEW TRADE PUBLICATIONS

PNEUMATIC TOOLS.—In a four-page circular issued by the Independent Pneumatic Tool Co., Chicago, its extensive line of pneumatic tools is illustrated and briefly described. The tools shown include air drills of various types, sand rammers, pneumatic hammers, chippers, etc.

OIL AND GAS BURNING APPLIANCES.—An eight-page bulletin recently issued by the Quigley Furnace & Foundry Co., New York City, describes this company's line of oil and gas burning appliances, including various types of burners, fuel oil pumping systems, blowers, etc.

FUEL OIL BURNING APPLIANCES.—In a 32-page catalog issued by Tate, Jones & Co., Pittsburgh, its line of burners for fuel oil is illustrated and described. Numerous views also are included showing the application of these burners to various types of furnaces. Pumping systems also are shown and details of operation are included.

GRINDER.—The Challenge Machine Co., Inc., Philadelphia, is sending to the trade a four-page folder describing its combination wet tool and dry grinder, equipped with a wheel guard. The machine is adapted for wet tool grinding and also for rough, dry grinding. It therefore is essentially two machines in one, thereby economizing floor space, power and reducing the cost of the initial investment.

PNEUMATIC HAMMERS. — A 12-page booklet describing chipping, calking and scaling hammers recently has been issued by the Ingersoll-Rand Co., 11 Broadway, New York City. The chipping hammers are used to advantage for cleaning castings and are employed extensively in foundry operations. An eight-page bulletin also has been issued by this company describing a hoist, which can be used to advantage in foundry work where the lift is greater than 20 feet.

FLEXIBLE SHAFTS.—A complete new catalog of flexible shafts, grinding machines, portable tools, etc., manufactured by the Stowe Mfg. Co., Binghamton, N. Y., has been issued recently. Illustrations, specifications, and prices of flexible shafts for every conceivable purpose are included. Considerable space, also, is allotted to specifications and illustrations of the Stowe portable emery grinding wheel, electric driven stationary grinders, variable speed, direct and alternating current motors, portable drills, etc. The catalog contains 94 pages and is provided with a comprehensive index which adds to its value for reference purposes.

DRINKING WATER SYSTEMS.—A catalog describing the Nonpareil core covering for drinking water systems in mills, factories, hotels, office buildings and hospitals has been issued by the Armstrong Core & Insulation Co. Illustrations are shown of this cover in service in various factories and buildings. The method of preparing this covering and the advantages of its use are described in detail.

BALL BEARINGS.—The Maschinenfabrik Rheinland, Aktien-Ges., Dusseldorf, Germany, with offices at 1377 Broadway, New York, has issued a large size, two color, 70-page catalog, giving a complete description of its line of ball bearings. The catalog is profusely illustrated and carries a large number of tables which will prove of value. It is bound in a loose-leaf, flexible cover, which adds greatly to its attractiveness.

SMOOTH-ON INSTRUCTION BOOK. — The most complete instruction book ever issued by the Smooth-On Mfg. Co., Jersey City, N. J., recently has been published. The book describes and illustrates the correct methods of using the company's eight different lines of iron cements, concrete, iron paint and coated corrugated iron gaskets. The instructions given for using the company's products are exceedingly complete and will prove of considerable value to any user.

WINCHES AND WINDING DRUMS.—Bulletin No. 48,901, issued by the Sprague Electric Works, of General Electric Co., 527 West Thirty-fourth street, New York, describes and illustrates the latest type of Sprague electric winches and winding drums. These devices are particularly useful in manufacturing plants for shifting freight cars without the aid of a locomotive. The bulletin contains a large number of full page illustrations showing interesting applications of electric winding drums and winches.